JAPANESE [JP,2005-006264,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]
In the mobile IP network system each other combined through the network repeating installation with which two or more segments into which two or more nodes containing a mobile node were registered existed, and each was equipped with these segments,
Said mobile node is equipped with a registration request means to request the purport which registers an own IP address into the segment from said network repeating installation with which the segment was equipped, in the segment of a migration place,
Said each of network repeating installation with which said two or more segments were equipped,

A registration means to register the host address of said mobile node as the logical address of an own port according to the request from said mobile node,
A public-relations means to publicize the host address of said mobile node to said other network repeating installation according to the request from said mobile node,
A renewal means of a table to register the network address of the network repeating installation of said public-relations origin into routing table as the destination corresponding to this while registering the host address publicized by network repeating installation besides the above as one of the network addresses of the destination,
When the network address which is in agreement with the host address which a subordinate's node specified as the destination exists in routing table, the network repeating installation shown at the network address registered corresponding to this host address is equipped with a routing means to transmit data.
The mobile IP network system characterized by things.
[Claim 2]
In a mobile IP network system according to claim 1,
Said network repeating installation,
A substitute reply means to return the response which contains an own MAC Address instead of said mobile node when the address detection demand to the mobile node which is moving to other segments from the node which exists in a subordinate's segment is received,
A reception vicarious execution means to receive the packet sent out from the node of the dispatch origin of said address detection demand instead of said mobile node,
It has a retransmission-of-message means to pass said mobile node anew to said routing means as the destination, and to broadcast again the packet which said reception vicarious execution means received.
The mobile IP network system characterized by things.
[Claim 3]
In a mobile IP network system according to claim 1,
Said mobile node,
A radio means to transmit and receive the information which sets to IP network and is made into it as a radio signal,
When it is under communication link, it has a notice means to notify the registration demand

including the IP address of the node of a communications partner to the network repeating installation which belongs to the segment of a migration place through said radio means,
Said network repeating installation,
A radio means to transmit and receive the information which sets to IP network and is made into it as a radio signal,
Capsulation of the packet encapsulated using the header of the purport which makes said network repeating installation the destination is canceled, and it has a capsule discharge means to transmit to the node belonging to a subordinate's segment,
The registration means of said network repeating installation,
A communications-partner detection means to detect the IP address of the node of the communications partner contained in the registration demand received through said radio means,

It has a change-notice means to transmit the registration place change notice which includes the IP address of a mobile node set as the object of registration by said registration demand, and the IP address of said network repeating installation which is the registration place of said mobile node in the node of said communications partner shown by the IP address detected by said communications-partner detection means,
The node of said communications partner,
A change-notice detection means to detect a registration place change notice including the IP address of the mobile node under communication link,
It has a capsulation means to encapsulate and send out, by adding the header which makes the destination network repeating installation which is the registration place of said mobile node to the packet which makes the mobile node under communication link the destination according to detection of said registration place change notice.
The mobile IP network system characterized by things.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
Especially this invention relates to the routing technique in a mobile IP network about a mobile IP network system.
In IP network system which connected the segment which is the unit network built using the LAN technique in each post in the company by WAN, a movable terminal like a notebook computer is included in each segment combined by WAN in many cases. In the segment to which the terminal belongs, i.e., a home network, the IP address is assigned to such a mobile node (Mobile Node:MN) as well as the terminal of immobilization, respectively.
[0002]
Thus, IP network system equipped with the structure which makes available the IP address which the mobile node was given also in the external network of a migration place is called a mobile IP network system in this specification.
[0003]
[Description of the Prior Art]
Drawing which explains IP network system to drawing 10 is shown.
The segment A shown in drawing 10 at network addresses 1.1.1.0/24 The segment B shown at network addresses 2.2.2.0/24, and the segment C shown at network addresses 3.3.3.0/24 It has the gateway routers A, B, and C, respectively, and they are these gateway routers A, B, and C (in drawing 10). respectively — Sign GWRa, and b and c — giving — being shown — it minds and three segments A, B, and C mentioned above are connected to WAN shown at network addresses 4.4.4.0/24.
[0004]
The gateway routers A, B, and C shown in drawing 10 are network repeating installation arranged at the node of the network of a different class like WAN and LAN, and are network devices which combine the gateway function to relay the data transmission between the segments in WAN and LAN, and the router ability which relays the data within a segment.
[0005]
In such an IP network of a configuration, in the communication link between the segments which go via WAN, routing of a network unit is performed based on the routing table with which each gateway router was equipped, and the data transfer within a segment is performing forwarding based on a MAC Address.
For example, if a packet is sent out by making into the destination the IP address (for example, 1.1.1.1) which shows the node A1 which belongs to Segment A from the node C1 belonging to the segment C shown in drawing 10 , the gateway router C with which Segment C was equipped will compare this IP address with the network address registered into routing table, and will transmit a packet to the destination (drawing 10 is shown as Next Hop) corresponding to the network address which was in agreement for a long time. In the example shown in drawing 10 , since network addresses 1.1.1.0/24 are the closest to the IP address of the destination, the gateway router C transmits a packet to the destination A registered into routing table

corresponding to this network address, i.e., the gateway router shown by IP address 4.4.4.1. The gateway router A which received this packet discovers the MAC Address corresponding to the IP address specified as the destination of a packet based on ARP (Address Resolution Protocol), and, finally passes a packet to the node A1 with this MAC Address.

[0006]

By the way, when the node A1 belonging to Segment A is a mobile node (a mobile node is called hereafter), though natural, it is possible [it] that this mobile node MN leaves the segment A which is a home network, and moves to another segment (for example, the segment B). In such a case, since available then becomes unnecessary [modification of a setup whenever it moves etc.] also in the segment B which is an external network as it is about the IP address given to this mobile node MN in the home network (that is, the segment A), the mobility of a mobile node can be demonstrated.

[0007]

Moreover, by restricting the IP address which can access the server in a segment to the IP address given to the terminal belonging to the segment When security is secured, a mobile node also sets to an external network. A server can be used for maintaining the IP address given by the home network like the time of the user of a mobile node being in a home network, when having connected with other segments possible then.

[0008]

Next, the technique which makes available the IP address which the mobile node was given in the home network in an external network is explained.

Drawing which explains a mobile IP network system to drawing 11 is shown. In addition, about a thing equivalent to each part shown in drawing 10 among the components shown in drawing 11 , the sign shown in drawing 10 is attached and shown, and the explanation is omitted.

[0009]

For example, when the mobile node MN belonging to the segment A shown in drawing 11 moves to Segment B, the mobile node MN requires registration of positional information of the gateway router B which achieves an external agent (FA) function in Segment B. While registering as a terminal with which this gateway router B belongs the mobile node MN to a subordinate's segment according to this, the positional information received from the mobile node MN to the gateway router A which achieves a home agent (HA) function in the home network (in this case, the segment A) of the mobile node MN is notified. The gateway router A which received this notice creates the transfer table for the mobile nodes MN apart from the routing table mentioned above based on the notified positional information, and registers the external agent's FA IP address (for example, 4.4.4.2) corresponding to the IP address (for example, 1.1.1.1) given to the mobile node MN.

[0010]

Thus, by the method by which the home agent HA and the external agent FA manage the current position of a mobile node, the routing table of each gateway routers A, B, and C is not changed at all. The packet to which the mobile node MN was transmitted as the destination from the node C1 belonging to the segment C which followed, for example, was shown in drawing 11 is transmitted to the gateway router A which is the home agent HA by the gateway router C (a sign (1) is attached and shown in drawing 11). This packet is transmitted to the external agent FA, after encapsulating by adding the header which includes the external agent's FA IP address registered into the transfer table mentioned above so that a sign (2) may be attached and the packet which the home agent HA mentioned above instead of the mobile node MN may once be shown in drawing 11 reception and after that at this time. Thus, the encapsulated packet is passed to the mobile node MN which is the original destination, after capsulation is canceled in the external agent FA so that a sign (3) may be attached and shown in drawing 11 .

[0011]

In addition, refer to the nonpatent literature 1 for the detail about a mobile IP network system as shown in drawing 11 .

[Nonpatent literature 1]

C. Perkins, Ed. Nokia Research Center "IP Mobility Support for Ipv4" August 2002 Network

Working Group Request for Comments: 3344
[0012]
[Problem(s) to be Solved by the Invention]
Thus, in the conventional mobile IP network system, the mobile node of the destination has transmitted the packet from the node (Sign CN is attached and shown in drawing 11) of a sending agency to the external agent FA irrespective of the segment which is carrying out the present group via the tunnel root created by the home agent HA with whom the home network of a mobile node was equipped.
Therefore, in the conventional mobile IP network system mentioned above, though the transmission route of the packet sent out by the node of a sending agency when the mobile node MN was moving to the external network FN is natural, compared with the case where the mobile node MN exists in a home network HN, it will become long sharply, and a transit delay will also increase with increase of transmission route length. Moreover, if the narrow path of a band exists in the middle of the so-called triangular path from the node CN of dispatch origin which was mentioned above to the external agent FA via the home agent HA, by increase of slight traffic, the transmission speed of this path will deteriorate sharply and will cause the further transit delay. And increase of a transit delay serves as a very serious failure, when realizing application for example, based on a VoIP technique, application which distributes a video stream in a mobile IP network system.
[0013]
Moreover, in order to transmit a packet via the tunnel root as shown in drawing 11 , the capsulation processing in the home agent HA becomes indispensable, and the processing burden of the gateway router which achieves a home agent function becomes large. Especially, in the application based on a VoIP technique, or the application which distributes a video stream, since a huge number of packets are sent out from the node CN of a sending agency, in order to encapsulate these packets duly, a very high throughput is required of the home agent HA.
[0014]
Furthermore, it is also one of the technical problems that each packet size increases and data transmission efficiency falls by capsulation processing in the home agent HA. the payload especially stored in each packet by VoIP -- the die length of the header, origin, -- even comparing -- since it is short, the decline in the data transmission efficiency by capsulation is serious. For example, when using the voice codec according to the advice G.729 by ITU-T, in order that the die length of the header, the origin containing a MAC header, IP header, an UDP header, and a RTP header, may go up to 78 bytes to the payload stored in each packet being 20 bytes or 40 bytes, data transmission efficiency is 0.408 even when a payload is 40 bytes, and if it results when a payload is 20 bytes, it is set to 0.256. Of course, if IP header including the external agent's FA IP address is added by the capsulation processing mentioned above, though natural, data transmission efficiency will fall further.
[0015]
This invention aims at offering IP network system which realizes the communication link which used the optimal path between the mobile node and the node of the communications partner in a mobile IP network.
[0016]
[Means for Solving the Problem]
The 1st [in connection with this invention] mobile IP network system consists of a registration request means with which a mobile node is equipped, and the registration means with which network repeating installation is equipped, a public-relations means, the renewal means of a table and a routing means.
The principle of the 1st [in connection with this invention] mobile IP network system is as follows.
These segments of each other are combined through the network repeating installation with which two or more segments into which two or more nodes in which a mobile IP network system contains a mobile node were registered existed, and each was equipped with them. That is, such network repeating installation has been arranged at the node with another network which

connects each segments and these segments, and has achieved the function to relay transfer of the packet between this another network and each segment. Moreover, in a mobile node, a registration request means requests the purport which registers an own IP address into the segment from the network repeating installation with which the segment was equipped in the segment of a migration place. On the other hand, in each network repeating installation with which two or more segments were equipped, a registration means registers the host address of a mobile node as the logical address of an own port according to the request from a mobile node. The public-relations means with which each network repeating installation is equipped publicizes the host address of a mobile node to other network repeating installation according to the request from a mobile node. The renewal means of a table with which each network repeating installation is equipped registers the network address of the network repeating installation of a publicizing agency into routing table as the destination corresponding to this while registering the host address publicized by other network repeating installation as one of the network addresses of the destination. The routing means with which each network repeating installation is equipped transmits data to the network repeating installation shown at the network address registered corresponding to this host address, when the network address which is in agreement with the host address which a subordinate's node specified as the destination exists in routing table.

[0017]

Thus, the actuation of the 1st constituted mobile IP network system is as follows.

When a mobile node separates from the segment A which is a home network and moves to another segment B, the network repeating installation of the segment B of a migration place receives a registration request from the registration request means with which this mobile node was equipped, and the host address of a mobile node shown by registration request is registered as the logical address of the port of that network repeating installation. Thereby, the physical port of network repeating installation functions on another network which consists only of original Segment B and this original mobile node as a node. Then, the public-relations means of the network repeating installation which received the registration request publicizes the node shown in this host address to other network repeating installation as an own subordinate's node, and reflects the relation between this host address and the network address corresponding to the network repeating installation of a migration place in routing table through the renewal means of a table offered on such network repeating installation. Therefore, when the node belonging to other segments C sends after that the packet which makes the destination the mobile node which moved to the segment B mentioned above The routing means with which the network repeating installation corresponding to this segment C was equipped The network repeating installation shown at the network address matched with the host address of a mobile node based on the routing table updated as mentioned above, That is, the packet mentioned above to the network repeating installation corresponding to the network of the migration place of a mobile node is transmitted.

[0018]

That is, in the 1st mobile IP network system mentioned above, the packet from the node of a sending agency can be directly transmitted to the network repeating installation belonging to the network of the migration place of a mobile node irrespective of the migration place of a mobile node. In this case, since it is not formed, though natural, capsulation of the tunnel root like before is also unnecessary.

[0019]

The 2nd [in connection with this invention] mobile IP network system is constituted in preparation for network repeating installation in the 1st mobile IP network system mentioned above in a substitute reply means, a reception vicarious execution means, and a retransmission-of-message means.

The principle of the 2nd [in connection with this invention] mobile IP network system is as follows.

[0020]

In the network repeating installation of the 1st mobile IP network system mentioned above, a substitute reply means returns the response which contains an own MAC Address instead of a

mobile node, when the address detection demand to the mobile node which is moving to other segments from the node which exists in a subordinate's segment is received. A reception vicarious execution means receives the packet sent out from the node of the dispatch origin of an address detection demand instead of a mobile node. As the destination, anew, a mobile node is passed to a routing means and a retransmission-of-message means broadcasts again the packet which the reception vicarious execution means received for it.

[0021]

Thus, the actuation of the 2nd constituted mobile IP network system is as follows.

When the address detection demand about the mobile node which is moving to other segments is detected, the substitute reply means of network repeating installation returns an own MAC Address to the node of the dispatch origin of an address detection demand, and receives the packet transmitted from this node with a reception vicarious execution means. Thus, the packet which the reception vicarious execution means received is passed to a routing means after adding the header which makes the destination the mobile node which is the original destination with a retransmission-of-message means, is addressed to this mobile node and broadcast again.

[0022]

Thus, fault when the node in which the network repeating installation which belongs to the home network to which the mobile node originally belongs in the 2nd mobile IP network system has the same network address as the mobile node which moved by executing reception of the response and packet to the address detection demand from the node belonging to the same segment by proxy, and presenting the junction processing by the routing means with the packet which received tends to communicate with a mobile node is cancelable.

[0023]

In this case, since the packet which the node of a sending agency transmitted is once received by the reception vicarious execution means of network repeating installation and it is anew transmitted by the retransmission-of-message means, the tunnel root for transmitting this packet is not formed. Therefore, capsulation is also unnecessary though natural.

In the 1st mobile IP network system mentioned above, while equipping a mobile node with a radio means and a notice means and equipping it with a radio means and a capsule discharge means at network repeating installation, the 3rd [in connection with this invention] mobile IP network system equips with a communications-partner detection means and a change-notice means the registration means with which network repeating installation is equipped, and a notice detection means and a capsulation means are constituted in preparation for the node of a communications partner.

[0024]

The principle of the 3rd [in connection with this invention] mobile IP network system is as follows.

In the mobile node of the 1st mobile IP network system mentioned above, a radio means transmits and receives the information which sets to IP network and is made into it as a radio signal. The notice means with which a mobile node is equipped notifies the registration demand including the IP address of the node of a communications partner to the network repeating installation which belongs to the segment of a migration place through a radio means, when it is under communication link. Moreover, in network repeating installation, the information which sets to IP network and is made into it is transmitted [a radio means] and received as a radio signal. A capsule discharge means cancels capsulation of the packet encapsulated using the header of the purport which makes network repeating installation the destination, and transmits it to the node belonging to a subordinate's segment. Moreover, in the registration means with which network repeating installation was equipped, a communications-partner detection means detects the IP address of the node of the communications partner contained in the registration demand received through the radio means. A change-notice means transmits the registration place change notice which includes the IP address of a mobile node set as the object of registration by registration demand, and the IP address of the network repeating installation which is the registration place of a mobile node in the node of the communications partner shown by the IP address detected by the communications-partner detection means. Moreover, in the node of a

communications partner, a change-notice detection means detects a registration place change notice including the IP address of the mobile node under communication link. A capsulation means is encapsulated and sent out by adding the header which makes the destination network repeating installation which is the registration place of a mobile node to the packet which makes the mobile node under communication link the destination according to detection of a registration place change notice.

[0025]

Thus, the actuation of the 3rd constituted mobile IP network system is as follows.

For example, after it moves while the mobile node which makes Segment A a home network had maintained the communication link condition with the node of a communications partner, and going into the area corresponding to a segment B which is different even in it and being registered as a node of Segment B, the notice means with which the mobile node was equipped sends out a registration place change notice including the network address which shows the network repeating installation of the IP address of a mobile node, and Segment B by making the node of a communications partner into the destination. On the other hand, the packet addressed and sent out to a mobile node henceforth if this registration place change notice is detected by the change-notice detection means in the node of a communications partner is encapsulated and sent out by the capsulation means using a header including the network address which shows the network repeating installation of Segment B. And the packet encapsulated in this way is canceled by the capsule discharge means with which the network repeating installation of the segment B which is the migration place of a mobile node was equipped, and is transmitted to a mobile node.

[0026]

Thus, by creating the tunnel root according to a registration place change notice to the network repeating installation of the segment B which an external agent deserves from the node of a communications partner, when a mobile node carries out roaming, the communication link with a communications partner can be maintained. Since the communication link in this case is maintained by the tunnel root mentioned above, according to public relations by the network repeating installation of the segment of a migration place, the updating activity done about the routing table with which each network repeating installation was equipped does not need to be converging it.

[0027]

[Embodiment of the Invention]

Hereafter, the operation gestalt of this invention is explained to a detail based on a drawing.

The 1st operation gestalt of IP network system in connection with this invention is shown in drawing 1 .

In IP network system shown in drawing 1 , the mobile node 210 has been moving to the segment B corresponding to the gateway router b shown in drawing 1 from the segment A corresponding to the gateway router a.

[0028]

In the mobile node 210 shown in drawing 1 , the communications control section 211 controlled the LAN interface (I/F) circuit 213 according to the directions from a user interface (I/F) 212, and is equipped with the function which addresses to the gateway router which exists in the segment connected, and multicasts a registration demand.

Moreover, in the gateway router b shown in drawing 1 , the LAN control section 222 receives the packet to the node which belongs to Segment B from the node which belongs the packet to the node which belongs to other segments from the node belonging to Segment B to delivery and other segments at the junction processing section 223 from the junction processing section 223, and sends it out to Segment B through the LAN interface circuitry 221 while it controls the data transfer in the interior of segment B through the LAN interface circuitry 221. Moreover, the junction processing section 223 shown in drawing 1 controls the WAN interface (I/F) circuit 225 based on the path information stored in routing table 224, and relays the exchange of the packet between WAN and Segment B.

[0029]

Moreover, in the gateway router b shown in drawing 1 , when a registration demand is received through the LAN interface circuitry 221, the registration processing section 226 sends out the respectively suitable directions for the port Management Department 227 and the path Research and Data Processing Department 228 so that it may mention later. The port Management Department 227 which showed drawing 1 operates the information about the physical port with which the gateway router b was equipped according to the directions from the registration processing section 226. Moreover, the path Research and Data Processing Department 228 which showed drawing 1 directs modification of path information to other gateway routers through the WAN interface circuitry 225 according to the directions from the registration processing section 226. Moreover, this path Research and Data Processing Department 228 updates the path information stored in routing table 224 according to the modification directions about the path information received through the directions from the registration processing section 226 or the WAN interface circuitry 225 mentioned above.

[0030]

Of course, other gateway routers a and c shown in drawing 1 are equipped with the same configuration as the gateway router b mentioned above.

Next, actuation of the mobile IP network system shown in drawing 1 is explained.

Drawing which explains actuation of a mobile IP network system to drawing 2 is shown. Moreover, the explanatory view of the actuation which updates routing table to drawing 3 is shown.

[0031]

In addition, in drawing 2 and drawing 3 , it is Sign GWRa, and b and c about the gateway routers a, b, and c with Sign MN in a mobile node, and Sign CN shows the node of the communications partner of a mobile node, respectively.

When this mobile node 210 has moved to Segment B, as shown in drawing 2 , the communications control section 211 of the mobile node 210 shown in drawing 1 is addressed to the network device which has an external agent function, and multicasts the registration demand to this segment B. At this time, the communications control section 211 of the mobile node 210 creates the registration demand including the IP address given to self in the segment A which is a home network, and sends it out to Segment B through the LAN interface circuitry 213.

[0032]

The gateway router b which received this registration demand returns ACK which shows that the registration demand was received to the mobile node 210 of a requiring agency (refer to drawing 2), and waits for ACK from the mobile node 210 of a requiring agency.

The communications control section 211 of the mobile node 210 returns ACK to the gateway router (GWRb shown in drawing 2) of the transmitting origin of ACK which received first by the LAN interface circuitry 213, and returns NACK of a purport which refuses a response to the network device of a transmitting agency about ACK which received henceforth. If it does in this way, also when two or more gateway routers belong to Segment B, a mobile node can be registered as a subordinate of any one gateway router.

[0033]

According to ACK from the mobile node 210 mentioned above, the registration processing section 226 of the gateway router b shown in drawing 1 directs the purport which registers delivery and this IP address into the port Management Department 227 for the IP address included in the registration demand as the logical address of an own physical port. The port Management Department 227 performs suitable actuation for the information about the physical port with which the LAN interface circuitry 221 was equipped, and makes it function according to these directions as a node of the network which consists only of a mobile node 210 which mentioned above the physical port used as the candidate for actuation by this, and the original segment B.

[0034]

Subsequently, the registration processing section 226 shown in drawing 1 requests the purport which publicizes to delivery the IP address of the mobile node 210 mentioned above to the path Research and Data Processing Department 228, and publicizes this IP address to other gateway

routers.
According to this request, the path Research and Data Processing Department 228 with which the gateway router b was equipped For example, general path information-interchange protocols, such as RIP (Routing Information Protocol) and OSPF (Open Shortest Path First), are followed. In WAN shown at network addresses 4.4.4.0/24 A 32-bit mask shows the IP address mentioned above as the host address of the mobile node 210, and it publicizes that this mobile node 210 was registered into the subordinate of the gateway router b (refer to drawing 2 and drawing 3).
[0035]
Subsequently, the path Research and Data Processing Department 228 with which the gateway router b was equipped registers into routing table 224 the information (direct) on a purport that the node which makes this the host address corresponding to the IP address (1.1.1.1/32) mentioned above exists in a subordinate's segment (refer to drawing 2 and drawing 3).
Moreover, while the path Research and Data Processing Department (not shown) with which the gateway router a and the gateway router c were equipped registers into routing table the host address (1.1.1.1/32) notified with the 32-bit mask by the public relations mentioned above as one of the network addresses used as the destination at this time, the IP address (4.4.4.2) of the gateway router b which is a publicizing agency as the destination corresponding to this destination is registered (refer to drawing 2 and drawing 3).
[0036]
Thus, renewal of the routing table with which each gateway router was equipped is completed. If the packet which makes the destination the mobile node 210 (sign MN of drawing 2) from the node CN belonging to the segment C corresponding to the gateway router c is sent out after that as shown in drawing 2 , as this packet is the following, it will be relayed to the mobile node 210.
[0037]
First, the junction processing section (not shown) with which the gateway router c was equipped performs routing processing about this packet based on the routing table in which information as shown in drawing 3 was stored (refer to drawing 2).
At this time, the junction processing section can be transmitted to the gateway router b corresponding to the segment B to which this mobile node 210 is carrying out the present group of the packet which makes the mobile node 210 the destination by choosing the network address of the destination according to a RONGESUTOMATCHI algorithm (refer to drawing 2).
[0038]
It is because the junction processing section with which each gateway router was equipped since the IP address of a mobile node was registered as a network address with the 32-bit mask obtains the comparison result of the purport which was in agreement for a long time in the routing table with which each gateway router was equipped when it compares all the bit strings that show this network address and the IP address of the destination as mentioned above.
[0039]
Moreover, transfer [in / it judges that it is addressed to the node to which this packet belongs to its subordinate's segment based on the information for which the junction processing section 223 shown in drawing 1 when it did in this way and the packet addressed to mobile node 210 reached the gateway router b was stored in routing table 224, and this packet is passed to the LAN control section 222, and / Segment B] processing is presented.
[0040]
Thus, about the mobile node registered into the routing table with which each gateway router was equipped, routing of the packet can be carried out to the shortest path of resulting [from the node CN of a sending agency] in a mobile node, by determining the destination by host root routing, without going via the tunnel root formed of the home agent corresponding to a mobile node.
[0041]
This solves the problem of the triangular path by going via the tunnel root, and since the packet which makes a mobile node the destination can be transmitted through the shortest path, the user of a mobile node can be provided with the service which applied the application using a

VoIP technique, and the application which distributes a video stream irrespective of whether a mobile node is in a home network, or it is in an external network.
[0042]
By the way, when the node CN of a sending agency exists in the home network of a mobile node, the node CN of a sending agency tends to require a MAC Address based on ARP on the assumption that a mobile node exists in the same segment as itself, and tends to perform a transfer of a packet within a segment. Since the response to the address demand based on ARP is not obtained though natural when the mobile node used as the destination is moving to other segments, it will become impossible however, for the node of a sending agency to transmit a packet to a mobile node.
[0043]
Next, how to transmit the packet from the node of the dispatch origin which exists in the home network of a mobile node to a mobile node is explained.
The 2nd operation gestalt of the mobile IP network system in connection with this invention is shown in drawing 4 .
In addition, about a thing equivalent to each part shown in drawing 1 among the components shown in drawing 4 , the sign shown in drawing 1 is attached and shown, and the explanation is omitted.
[0044]
The gateway router a shown in drawing 4 and the node CN of a sending agency belong to the segment A which is the home network to which the mobile node 210 originally belongs.
The vicarious execution processing section 229 is equipped with the function to answer a MAC Address demand instead of a mobile node as it mentions later, and to receive the packet addressed to a mobile node, in the gateway router a shown in drawing 4 .
[0045]
Drawing which explains actuation of a mobile IP network system to drawing 5 is shown.
In addition, in drawing 5 , it is Sign GWRa, and b and c about the gateway routers a, b, and c with Sign MN in a mobile node, and Sign CN shows the node of the communications partner of a mobile node, respectively.
The vicarious execution processing section 229 shown in drawing 4 returns the response (PROXY ARP) containing an own MAC Address to the node CN of the dispatch origin of a demand to this address demand (ARP), when the address demand to the mobile node MN which is moving to the external network out of the address demand sent from the node CN of the dispatch origin belonging to Segment A is detected (refer to drawing 5). Then, the vicarious execution processing section 229 shown in drawing 4 receives the packet sent out to mobile node MN from the node CN of this dispatch origin instead of the mobile node MN (refer to drawing 5), and presents processing of the LAN control section 222 with the packet which received by making the mobile node MN into the destination anew.
[0046]
In this case, since the mobile node MN recognizes that current does not exist in Segment A, the junction processing which minds delivery and WAN for the packet received from the vicarious execution processing section 229 at the junction processing section 223 is presented with the LAN control section 222.
As drawing 5 was shown, registration processing which the mobile node mentioned above in the phase moved to Segment B is performed, and renewal of routing table is also completed.
Therefore, when the junction processing section 223 with which the gateway router a was equipped performs routing processing based on the information stored in routing table 224, the packet of addressing to mobile node MN mentioned above is transmitted to the gateway router b corresponding to the segment b into which this mobile node MN is registered now, and the mobile node MN is reached further (refer to drawing 5).
[0047]
Thus, the packet sent out to a home network by making a mobile node into the destination from the node of the dispatch origin which exists in a home network can be transmitted to the mobile node registered into the external network by equipping the gateway router a which exists in the

home network of a mobile node with the vicarious-execution processing section 229 which achieves the function receive the function and packet which answer an address demand instead of a mobile node according to the 2nd [in connection with this invention] mobile IP network system.

[0048]

By the way, when the mobile node is equipped with the radio function, a mobile node may move between segments to the midst which has received distribution of a music title and image software from the node CN of a communications partner.

Next, how to realize moving between segments while the mobile node equipped with the radio function had maintained the communication link, i.e., roaming, is explained.

[0049]

The operation gestalt of the 3rd [in connection with this invention] mobile IP network system is shown in drawing 6 .

In addition, about a thing equivalent to each part shown in drawing 1 among the components shown in drawing 6 , the sign shown in drawing 1 is attached and shown, and the explanation is omitted.

The mobile node 210 shown in drawing 6 was replaced with the LAN interface circuitry 213, and is equipped with the wireless LAN interface circuitry 231. Moreover, the gateway router b shown in drawing 6 is equipped with the wireless LAN interface 232. Of course, the gateway router b may be equipped with the LAN interface circuitry (not shown) of a cable.

[0050]

This mobile node 210 moves during a communication link with another node, and the communications control section 211 of the mobile node 210 shown in drawing 6 sends out the registration demand including the information on the purport which is communicating with the IP address of the node of a communications partner through the wireless LAN interface circuitry 231, when it advances into a segment which is different even in it.

In the gateway router b shown in drawing 6 , the registration processing section 226 directs sending out of delivery and a registration place change notice for the IP address of a mobile node in the notice processing section 233 with the IP address of the communications partner contained in this registration demand, when the information on the purport which is communicating from the mobile node 210 to a registration demand is included. According to this, the notice processing section 233 creates the registration place change notice which shows that the segment into which the mobile node is registered changed using the IP address passed from the registration processing section 226, and sends out this registration place change notice to the LAN control section 222 as a packet which makes the node of a communications partner the destination.

[0051]

On the other hand, in the node CN of the communications partner shown in drawing 6 , the service processing section 214 is performing processing about distribution service of for example, image software, and sends out the packet containing the image data for distribution to a network through the communications control section 234. Moreover, in addition to the same function as the communications control section 211 shown in drawing 1 , the communications control section 234 shown in drawing 6 is equipped with the function for corresponding to the roaming of this node CN and the mobile node under communication link.

[0052]

The detail configuration of the function in connection with roaming processing is shown in drawing 7 .

In the node of the dispatch origin shown in drawing 7 , since it corresponds to the roaming of a mobile node, the communications control section 234 is equipped with the notice detecting element 238 which detects the registration place change notice mentioned above, the capsulation processing section 239 which encapsulates the packet to the mobile node 210 in connection with a registration place change notice, and the termination detecting element 240 which detects termination of the data distribution to a mobile node.

[0053]

Moreover, it sets in the junction processing section 223 with which the gateway router b shown in drawing 7 was equipped, and the packet junction control section 236 controls the exchange of the packet between Segments B and WAN which is not encapsulated. On the other hand, the capsule discharge section 235 shown in drawing 7 sends out the packet canceled and obtained [capsulation / reception and] in the packet encapsulated through the packet distribution section 237 to Segment B through the packet junction control section 236.

[0054]

Hereafter, actuation of the 3rd mobile IP network system shown in drawing 6 is explained. Drawing which explains actuation of the 3rd mobile IP network system to drawing 8 is shown. In addition, in drawing 8 , it is Sign GWRa, and b and c about the gateway routers a, b, and c with Sign MN in a mobile node, and Sign CN shows the node of the communications partner of a mobile node, respectively.

[0055]

For example, when the mobile node 210 shown in drawing 6 exists in the segment A which is a home network, as shown in drawing 8 , the packet of the node CN of the communications partner belonging to Segment C to addressing to mobile node MN is passed to GWRa by GWRc through WAN, and is further passed to the mobile node MN through this GWRa. When the mobile node MN moves to Segment B as it does not release the connection between the node CN of this communications partner, and the mobile node MN The communications control section 211 of the mobile node 210 shown in drawing 6 In addition to an own IP address, the registration demand including the information on the purport which is communicating with the IP address of a communications partner is created, and this registration demand is sent out to the gateway router b of Segment B through the wireless LAN interface circuitry 231 (refer to drawing 8).

[0056]

The registration processing section 226 of the gateway router b shown in drawing 6 according to this registration demand directs sending out of a registration place change notice in the notice processing section 233 shown in drawing 6 and drawing 7 while starting the processing for registering the mobile node 210 into Segment B. According to these directions, the notice processing section 233 creates a registration place change notice including the IP address of the mobile node 210, and the IP address of the gateway router b, and sends it out to the LAN control section 222 as a packet which makes the node CN of a communications partner the destination.

[0057]

The packet containing such a registration place change notice is passed to the packet junction control section 236 with which the junction processing section 223 was equipped from the LAN control section 222. This packet junction control section 236 passes the packet containing the registration place change notice mentioned above to the WAN interface circuitry 225 based on the path information stored in routing table 224, and sends it out to the node CN of a communications partner through the gateway router c belonging to WAN and Segment C (refer to drawing 8).

[0058]

Thus, when the packet containing a registration place change notice reaches the LAN interface circuitry 213 of the node CN of a communications partner, the notice detecting element 238 with which the communications control section 234 shown in drawing 7 was equipped extracts the IP address of the mobile node 210 which is a communications partner, and the IP address of the gateway router b which achieves an external agent function in that registration place from a registration place change notice, notifies these IP addresses to the capsulation processing section 239, and starts this capsulation processing section 239. Whenever this capsulation processing section 239 receives the packet which makes the mobile node 210 the destination from the service processing section 214, it adds and encapsulates henceforth the header which includes the IP address of the gateway router b which is the new registration place of the mobile node 210 in this packet (refer to drawing 8), and passes this encapsulated packet (a capsulation packet is called hereafter) to the LAN interface circuitry 213.

[0059]

This capsulation packet is sent out to Segment C through the LAN interface circuitry 213 of the node CN of a communications partner, and is further passed to the gateway router c belonging to this segment C (refer to drawing 7 and drawing 8).
This capsulation packet is equipped with the header including the IP address of the gateway router b as mentioned above. Therefore, when the gateway router c performs the usual routing processing based on this header, this capsulation packet is transmitted to the gateway router b which is the migration place of the mobile node 210 through WAN (refer to drawing 8). **
When such a capsulation packet reaches the WAN interface circuitry 225 of the gateway router b, the packet distribution section 237 with which the junction processing section 223 shown in drawing 7 was equipped passes a capsulation packet to the capsule discharge section 235. This capsule discharge section 235 removes the header which includes an own IP address from a capsulation packet, and separates the packet addressed to mobile node 210.
[0060]
Thus, the packet of separated addressing to mobile node 210 is passed to the packet junction control section 236 by the packet distribution section 237 with the usual packet separated with the capsulation packet, and is passed to the mobile node 210 through the LAN control section 222 and the wireless LAN interface circuitry 232 (refer to drawing 8).
If it does in this way, the capsulation packet containing the packet sent out from the service processing section 214 with which Node CN was equipped can be passed to the mobile node 210 irrespective of whether it is being completed by the routing table in each gateway router via the tunnel root (half tone dot meshing is attached and shown in drawing 8) set up between Node CN and the gateway router b.
[0061]
While the mobile node 210 receives service of distribution of the image data from the node CN of a communications partner etc., in case it moves to other segments by this, a communication link condition required for distribution of data can be maintained.
Distribution of the capsulation packet which went via the tunnel root mentioned above is similarly repeated till termination of distribution of image data and music data for example, for distribution. In parallel to this, processing which updates routing table in each gateway router according to the processing and this which the gateway router b publicizes the IP address of the mobile node 210 is performed according to the registration demand mentioned above.
[0062]
Therefore, when transmission of the stream which was under distribution when the mobile node 210 sent out the registration demand is completed, it can expect to already have converged the routing table with which each gateway router was equipped.
Therefore, the packet sent out to mobile node 210 from the service processing section 214 henceforth can be transmitted by the routing processing based on the convergent routing table according to the same procedure as the case where it is shown in drawing 3 .
[0063]
Here, the termination detecting element 240 shown in drawing 7 is equipped with the function to direct a halt of capsulation processing in the capsulation processing section 239, when the stream data inputted into the capsulation processing section 239 are supervised and the completion of distribution of stream data is detected. According to these directions, the capsulation processing section 239 passes the packet from the service processing section 214 to the LAN interface circuitry 213 as it is henceforth.
[0064]
If it does in this way, according to the completion of distribution of stream data, the tunnel root between Node CN and the gateway router b can be canceled, he can send out each packet which transmits henceforth to Segment C through the LAN interface circuitry 213, and you can leave it to the routing processing by the gateway router c (refer to drawing 8).
Moreover, if a procedure as shown in drawing 9 is used for example, it is also possible to cancel the tunnel root according to the completion of convergence of routing table.
[0065]
As shown in drawing 9 , the gateway router b which is the new registration place of the mobile

node 210 transmits Ping which showed the IP address of the mobile node 210 as a sending agency to the node CN of a communications partner, when renewal of the own routing table 224 is completed.
If are being completed by the routing table with which the gateway router c corresponding to this node CN was equipped, and routing is carried out to the gateway router b corresponding to the segment B in which the mobile node 210 of a sending agency is carrying out the current group with the gateway router c and it is not converging, routing of the Ping returned from Node CN will be carried out to the gateway router corresponding to the segment to which the mobile node 210 belonged before.
[0066]
Therefore, it can judge whether the routing table with which the gateway router c corresponding to Node CN was equipped by whether the response to Ping to the node CN mentioned above comes on the contrary is converging the gateway router b.
As shown in drawing 9 , when routing of the response to Ping to the node CN mentioned above is carried out to the gateway router b by the gateway router c, it judges that convergence of the routing table with which the gateway router c was equipped has completed the gateway router b, and the packet which includes tunnel discharge directions in the node CN of a communications partner is sent out. In addition, although the destination of the response to Ping mentioned above is the mobile node 210, the gateway router b does not need to relay this response to the mobile node 210.
[0067]
On the other hand, the tunnel discharge directions sent out by the gateway router b are passed to Node CN through the gateway router c, and the communications control section 234 of Node CN suspends the processing which encapsulates the packet from the service processing section 214 according to this. Therefore, the packet containing the stream data under distribution is sent out to Segment C through the LAN interface circuitry 213 as it is, and the routing processing by the gateway router c is presented with it henceforth.
[0068]
The mobile IP network system of which the tunnel root is canceled with the application of such a procedure In for example, the junction processing section 223 of the gateway router (drawing 6 the gateway router b) of a segment with which the mobile node 210 is registered It has the convergence test section which performs the procedure mentioned above and judges the completion of convergence of routing table. Moreover, it replaces with the termination detecting element 240 shown in the communications control section 234 of the node of a communications partner at drawing 7 , and can realize by having the discharge directions reception section which directs a halt of capsulation processing according to reception of tunnel discharge directions.
[0069]
[Effect of the Invention]
As explained above, according to the 1st [in connection with this invention] mobile IP network system, the packet sent out from the node of a communications partner can be transmitted to the mobile node registered into the external network using host root routing by registering the host address of a mobile node into the routing table with which network repeating installation was equipped. This solves the problem of the triangular path which was a technical problem in a Prior art, and when the mobile node is registered into the external network, it becomes possible to transmit the packet sent from the node of a communications partner to a mobile node through the shortest path. Therefore, according to such 1st mobile IP network system, it is expectable for offer of the service which is easy to receive the effect of transit delays, such as service which applied the VoIP technique, and video stream distribution service, in the user of a mobile node to be attained irrespective of whether a mobile node is in a home network, or it is in an external network.
[0070]
Especially, in the 2nd [in connection with this invention] mobile IP network system, when the network repeating installation belonging to a home network performs a required procedure instead of a mobile node in the case of the communication link with the node belonging to the

home network of a mobile node, the packet sent from the node belonging to a home network can also be certainly transmitted to the mobile node of a migration place.

[0071]

Moreover, according to the 3rd [in connection with this invention] mobile IP network system, the communication link between the nodes CN of a communications partner is maintainable irrespective of modification of the registration place of a mobile node by setting up the tunnel root between the network repeating installation of the migration place of a partner's node CN and a mobile node with which the mobile node is communicating. While this receives service, distribution service of a video stream, etc. of the voice message using for example, a VoIP technique etc., it also becomes possible enough for the user of a mobile node to do roaming.

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the operation gestalt of the 1st [in connection with this invention] mobile IP network system.

[Drawing 2] It is drawing explaining actuation of the 1st mobile IP network system.

[Drawing 3] It is drawing explaining the actuation which updates routing table.

[Drawing 4] It is drawing showing the operation gestalt of the 2nd [in connection with this invention] mobile IP network system.

[Drawing 5] It is drawing explaining actuation of the 2nd mobile IP network system.

[Drawing 6] It is drawing showing the operation gestalt of the 3rd [in connection with this invention] mobile IP network system.

[Drawing 7] It is drawing showing the detail configuration of the function in connection with roaming processing.

[Drawing 8] It is drawing explaining actuation of the 3rd mobile IP network system.

[Drawing 9] It is drawing explaining another actuation of the 3rd mobile IP network system.

[Drawing 10] It is drawing explaining IP network system.

[Drawing 11] It is drawing explaining a mobile IP network system.

[Description of Notations]

210 Mobile Node
211 234 Communications control section
212 User Interface (I/F)
213 221 LAN interface (I/F) circuit
221 LAN Interface Circuitry
222 LAN Control Section
223 Junction Processing Section
224 Routing Table
225 WAN Interface (I/F) Circuit
226 Registration Processing Section
227 Port Management Department
228 Path Research and Data Processing Department
229 Vicarious Execution Processing Section
231 232 Wireless LAN interface circuitry
233 Notice Processing Section
235 Capsule Discharge Section
236 Packet Junction Control Section
237 Packet Distribution Section
238 Notice Detecting Element
239 Capsulation Processing Section
240 Termination Detecting Element

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention]
Especially this invention relates to the routing technique in a mobile IP network about a mobile IP network system.
In IP network system which connected the segment which is the unit network built using the LAN technique in each post in the company by WAN, a movable terminal like a notebook computer is included in each segment combined by WAN in many cases. In the segment to which the terminal belongs, i.e., a home network, the IP address is assigned to such a mobile node (Mobile Node:MN) as well as the terminal of immobilization, respectively.
[0002]
Thus, IP network system equipped with the structure which makes available the IP address which the mobile node was given also in the external network of a migration place is called a mobile IP network system in this specification.
[0003]

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art]
Drawing which explains IP network system to drawing 10 is shown.
The segment A shown in drawing 10 at network addresses 1.1.1.0/24 The segment B shown at network addresses 2.2.2.0/24, and the segment C shown at network addresses 3.3.3.0/24 It has the gateway routers A, B, and C, respectively, and they are these gateway routers A, B, and C (in drawing 10). respectively — Sign GWRa, and b and c — giving — being shown — it minds and three segments A, B, and C mentioned above are connected to WAN shown at network addresses 4.4.4.0/24.
[0004]
The gateway routers A, B, and C shown in drawing 10 are network repeating installation arranged at the node of the network of a different class like WAN and LAN, and are network devices which combine the gateway function to relay the data transmission between the segments in WAN and LAN, and the router ability which relays the data within a segment.
[0005]
In such an IP network of a configuration, in the communication link between the segments which go via WAN, routing of a network unit is performed based on the routing table with which each gateway router was equipped, and the data transfer within a segment is performing forwarding based on a MAC Address.
For example, if a packet is sent out by making into the destination the IP address (for example, 1.1.1.1) which shows the node A1 which belongs to Segment A from the node C1 belonging to the segment C shown in drawing 10 , the gateway router C with which Segment C was equipped will compare this IP address with the network address registered into routing table, and will transmit a packet to the destination (drawing 10 is shown as Next Hop) corresponding to the network address which was in agreement for a long time. In the example shown in drawing 10 , since network addresses 1.1.1.0/24 are the closest to the IP address of the destination, the gateway router C transmits a packet to the destination A registered into routing table corresponding to this network address, i.e., the gateway router shown by IP address 4.4.4.1. The gateway router A which received this packet discovers the MAC Address corresponding to the IP address specified as the destination of a packet based on ARP (Address Resolution Protocol), and, finally passes a packet to the node A1 with this MAC Address.
[0006]
By the way, when the node A1 belonging to Segment A is a mobile node (a mobile node is called hereafter), though natural, it is possible [it] that this mobile node MN leaves the segment A which is a home network, and moves to another segment (for example, the segment B). In such a case, since available then becomes unnecessary [modification of a setup whenever it moves etc.] also in the segment B which is an external network as it is about the IP address given to this mobile node MN in the home network (that is, the segment A), the mobility of a mobile node can be demonstrated.
[0007]
Moreover, by restricting the IP address which can access the server in a segment to the IP address given to the terminal belonging to the segment When security is secured, a mobile node

also sets to an external network. A server can be used for maintaining the IP address given by the home network like the time of the user of a mobile node being in a home network, when having connected with other segments possible then.
[0008]
Next, the technique which makes available the IP address which the mobile node was given in the home network in an external network is explained.
Drawing which explains a mobile IP network system to drawing 11 is shown. In addition, about a thing equivalent to each part shown in drawing 10 among the components shown in drawing 11 , the sign shown in drawing 10 is attached and shown, and the explanation is omitted.
[0009]
For example, when the mobile node MN belonging to the segment A shown in drawing 11 moves to Segment B, the mobile node MN requires registration of positional information of the gateway router B which achieves an external agent (FA) function in Segment B. While registering as a terminal with which this gateway router B belongs the mobile node MN to a subordinate's segment according to this, the positional information received from the mobile node MN to the gateway router A which achieves a home agent (HA) function in the home network (in this case, the segment A) of the mobile node MN is notified. The gateway router A which received this notice creates the transfer table for the mobile nodes MN apart from the routing table mentioned above based on the notified positional information, and registers the external agent's FA IP address (for example, 4.4.4.2) corresponding to the IP address (for example, 1.1.1.1) given to the mobile node MN.
[0010]
Thus, by the method by which the home agent HA and the external agent FA manage the current position of a mobile node, the routing table of each gateway routers A, B, and C is not changed at all. The packet to which the mobile node MN was transmitted as the destination from the node C1 belonging to the segment C which followed, for example, was shown in drawing 11 is transmitted to the gateway router A which is the home agent HA by the gateway router C (a sign (1) is attached and shown in drawing 11). This packet is transmitted to the external agent FA, after encapsulating by adding the header which includes the external agent's FA IP address registered into the transfer table mentioned above so that a sign (2) may be attached and the packet which the home agent HA mentioned above instead of the mobile node MN may once be shown in drawing 11 reception and after that at this time. Thus, the encapsulated packet is passed to the mobile node MN which is the original destination, after capsulation is canceled in the external agent FA so that a sign (3) may be attached and shown in drawing 11 .
[0011]
In addition, refer to the nonpatent literature 1 for the detail about a mobile IP network system as shown in drawing 11 .
[Nonpatent literature 1]
C. Perkins, Ed. Nokia Research Center "IP Mobility Support for Ipv4" August 2002 Network Working Group Request for Comments: 3344
[0012]

[Translation done.]

* NOTICES *

EFFECT OF THE INVENTION

[Effect of the Invention]
As explained above, according to the 1st [in connection with this invention] mobile IP network system, the packet sent out from the node of a communications partner can be transmitted to the mobile node registered into the external network using host root routing by registering the host address of a mobile node into the routing table with which network repeating installation was equipped. This solves the problem of the triangular path which was a technical problem in a Prior art, and when the mobile node is registered into the external network, it becomes possible to transmit the packet sent from the node of a communications partner to a mobile node through the shortest path. Therefore, according to such 1st mobile IP network system, it is expectable for offer of the service which is easy to receive the effect of transit delays, such as service which applied the VoIP technique, and video stream distribution service, in the user of a mobile node to be attained irrespective of whether a mobile node is in a home network, or it is in an external network.
[0070]
Especially, in the 2nd [in connection with this invention] mobile IP network system, when the network repeating installation belonging to a home network performs a required procedure instead of a mobile node in the case of the communication link with the node belonging to the home network of a mobile node, the packet sent from the node belonging to a home network can also be certainly transmitted to the mobile node of a migration place.
[0071]
Moreover, according to the 3rd [in connection with this invention] mobile IP network system, the communication link between the nodes CN of a communications partner is maintainable irrespective of modification of the registration place of a mobile node by setting up the tunnel root between the network repeating installation of the migration place of a partner's node CN and a mobile node with which the mobile node is communicating. While this receives service, distribution service of a video stream, etc. of the voice message using for example, a VoIP technique etc., it also becomes possible enough for the user of a mobile node to do roaming.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]
Thus, in the conventional mobile IP network system, the mobile node of the destination has transmitted the packet from the node (Sign CN is attached and shown in drawing 11) of a sending agency to the external agent FA irrespective of the segment which is carrying out the present group via the tunnel root created by the home agent HA with whom the home network of a mobile node was equipped.
Therefore, in the conventional mobile IP network system mentioned above, though the transmission route of the packet sent out by the node of a sending agency when the mobile node MN was moving to the external network FN is natural, compared with the case where the mobile node MN exists in a home network HN, it will become long sharply, and a transit delay will also increase with increase of transmission route length. Moreover, if the narrow path of a band exists in the middle of the so-called triangular path from the node CN of dispatch origin which was mentioned above to the external agent FA via the home agent HA, by increase of slight traffic, the transmission speed of this path will deteriorate sharply and will cause the further transit delay. And increase of a transit delay serves as a very serious failure, when realizing application for example, based on a VoIP technique, application which distributes a video stream in a mobile IP network system.
[0013]
Moreover, in order to transmit a packet via the tunnel root as shown in drawing 11 , the capsulation processing in the home agent HA becomes indispensable, and the processing burden of the gateway router which achieves a home agent function becomes large. Especially, in the application based on a VoIP technique, or the application which distributes a video stream, since a huge number of packets are sent out from the node CN of a sending agency, in order to encapsulate these packets duly, a very high throughput is required of the home agent HA.
[0014]
Furthermore, it is also one of the technical problems that each packet size increases and data transmission efficiency falls by capsulation processing in the home agent HA. the payload especially stored in each packet by VoIP -- the die length of the header, origin, -- even comparing -- since it is short, the decline in the data transmission efficiency by capsulation is serious. For example, when using the voice codec according to the advice G.729 by ITU-T, in order that the die length of the header, the origin containing a MAC header, IP header, an UDP header, and a RTP header, may go up to 78 bytes to the payload stored in each packet being 20 bytes or 40 bytes, data transmission efficiency is 0.408 even when a payload is 40 bytes, and if it results when a payload is 20 bytes, it is set to 0.256. Of course, if IP header including the external agent's FA IP address is added by the capsulation processing mentioned above, though natural, data transmission efficiency will fall further.
[0015]
This invention aims at offering IP network system which realizes the communication link which used the optimal path between the mobile node and the node of the communications partner in a mobile IP network.
[0016]

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem]
The 1st [in connection with this invention] mobile IP network system consists of a registration request means with which a mobile node is equipped, and the registration means with which network repeating installation is equipped, a public-relations means, the renewal means of a table and a routing means.
The principle of the 1st [in connection with this invention] mobile IP network system is as follows.
These segments of each other are combined through the network repeating installation with which two or more segments into which two or more nodes in which a mobile IP network system contains a mobile node were registered existed, and each was equipped with them. That is, such network repeating installation has been arranged at the node with another network which connects each segments and these segments, and has achieved the function to relay transfer of the packet between this another network and each segment. Moreover, in a mobile node, a registration request means requests the purport which registers an own IP address into the segment from the network repeating installation with which the segment was equipped in the segment of a migration place. On the other hand, in each network repeating installation with which two or more segments were equipped, a registration means registers the host address of a mobile node as the logical address of an own port according to the request from a mobile node. The public-relations means with which each network repeating installation is equipped publicizes the host address of a mobile node to other network repeating installation according to the request from a mobile node. The renewal means of a table with which each network repeating installation is equipped registers the network address of the network repeating installation of a publicizing agency into routing table as the destination corresponding to this while registering the host address publicized by other network repeating installation as one of the network addresses of the destination. The routing means with which each network repeating installation is equipped transmits data to the network repeating installation shown at the network address registered corresponding to this host address, when the network address which is in agreement with the host address which a subordinate's node specified as the destination exists in routing table.
[0017]
Thus, the actuation of the 1st constituted mobile IP network system is as follows.
When a mobile node separates from the segment A which is a home network and moves to another segment B, the network repeating installation of the segment B of a migration place receives a registration request from the registration request means with which this mobile node was equipped, and the host address of a mobile node shown by registration request is registered as the logical address of the port of that network repeating installation. Thereby, the physical port of network repeating installation functions on another network which consists only of original Segment B and this original mobile node as a node. Then, the public-relations means of the network repeating installation which received the registration request publicizes the node shown in this host address to other network repeating installation as an own subordinate's node, and reflects the relation between this host address and the network address corresponding to the network repeating installation of a migration place in routing table through the renewal means

of a table offered on such network repeating installation. Therefore, when the node belonging to other segments C sends after that the packet which makes the destination the mobile node which moved to the segment B mentioned above The routing means with which the network repeating installation corresponding to this segment C was equipped The network repeating installation shown at the network address matched with the host address of a mobile node based on the routing table updated as mentioned above, That is, the packet mentioned above to the network repeating installation corresponding to the network of the migration place of a mobile node is transmitted.

[0018]

That is, in the 1st mobile IP network system mentioned above, the packet from the node of a sending agency can be directly transmitted to the network repeating installation belonging to the network of the migration place of a mobile node irrespective of the migration place of a mobile node. In this case, since it is not formed, though natural, capsulation of the tunnel root like before is also unnecessary.

[0019]

The 2nd [in connection with this invention] mobile IP network system is constituted in preparation for network repeating installation in the 1st mobile IP network system mentioned above in a substitute reply means, a reception vicarious execution means, and a retransmission-of-message means.

The principle of the 2nd [in connection with this invention] mobile IP network system is as follows.

[0020]

In the network repeating installation of the 1st mobile IP network system mentioned above, a substitute reply means returns the response which contains an own MAC Address instead of a mobile node, when the address detection demand to the mobile node which is moving to other segments from the node which exists in a subordinate's segment is received. A reception vicarious execution means receives the packet sent out from the node of the dispatch origin of an address detection demand instead of a mobile node. As the destination, anew, a mobile node is passed to a routing means and a retransmission-of-message means broadcasts again the packet which the reception vicarious execution means received for it.

[0021]

Thus, the actuation of the 2nd constituted mobile IP network system is as follows.

When the address detection demand about the mobile node which is moving to other segments is detected, the substitute reply means of network repeating installation returns an own MAC Address to the node of the dispatch origin of an address detection demand, and receives the packet transmitted from this node with a reception vicarious execution means. Thus, the packet which the reception vicarious execution means received is passed to a routing means after adding the header which makes the destination the mobile node which is the original destination with a retransmission-of-message means, is addressed to this mobile node and broadcast again.

[0022]

Thus, fault when the node in which the network repeating installation which belongs to the home network to which the mobile node originally belongs in the 2nd mobile IP network system has the same network address as the mobile node which moved by executing reception of the response and packet to the address detection demand from the node belonging to the same segment by proxy, and presenting the junction processing by the routing means with the packet which received tends to communicate with a mobile node is cancelable.

[0023]

In this case, since the packet which the node of a sending agency transmitted is once received by the reception vicarious execution means of network repeating installation and it is anew transmitted by the retransmission-of-message means, the tunnel root for transmitting this packet is not formed. Therefore, capsulation is also unnecessary though natural.

In the 1st mobile IP network system mentioned above, while equipping a mobile node with a radio means and a notice means and equipping it with a radio means and a capsule discharge means at network repeating installation, the 3rd [in connection with this invention] mobile IP network

system equips with a communications-partner detection means and a change-notice means the registration means with which network repeating installation is equipped, and a notice detection means and a capsulation means are constituted in preparation for the node of a communications partner.

[0024]

The principle of the 3rd [in connection with this invention] mobile IP network system is as follows.

In the mobile node of the 1st mobile IP network system mentioned above, a radio means transmits and receives the information which sets to IP network and is made into it as a radio signal. The notice means with which a mobile node is equipped notifies the registration demand including the IP address of the node of a communications partner to the network repeating installation which belongs to the segment of a migration place through a radio means, when it is under communication link. Moreover, in network repeating installation, the information which sets to IP network and is made into it is transmitted [a radio means] and received as a radio signal. A capsule discharge means cancels capsulation of the packet encapsulated using the header of the purport which makes network repeating installation the destination, and transmits it to the node belonging to a subordinate's segment. Moreover, in the registration means with which network repeating installation was equipped, a communications-partner detection means detects the IP address of the node of the communications partner contained in the registration demand received through the radio means. A change-notice means transmits the registration place change notice which includes the IP address of a mobile node set as the object of registration by registration demand, and the IP address of the network repeating installation which is the registration place of a mobile node in the node of the communications partner shown by the IP address detected by the communications-partner detection means. Moreover, in the node of a communications partner, a change-notice detection means detects a registration place change notice including the IP address of the mobile node under communication link. A capsulation means is encapsulated and sent out by adding the header which makes the destination network repeating installation which is the registration place of a mobile node to the packet which makes the mobile node under communication link the destination according to detection of a registration place change notice.

[0025]

Thus, the actuation of the 3rd constituted mobile IP network system is as follows.

For example, after it moves while the mobile node which makes Segment A a home network had maintained the communication link condition with the node of a communications partner, and going into the area corresponding to a segment B which is different even in it and being registered as a node of Segment B, the notice means with which the mobile node was equipped sends out a registration place change notice including the network address which shows the network repeating installation of the IP address of a mobile node, and Segment B by making the node of a communications partner into the destination. On the other hand, the packet addressed and sent out to a mobile node henceforth if this registration place change notice is detected by the change-notice detection means in the node of a communications partner is encapsulated and sent out by the capsulation means using a header including the network address which shows the network repeating installation of Segment B. And the packet encapsulated in this way is canceled by the capsule discharge means with which the network repeating installation of the segment B which is the migration place of a mobile node was equipped, and is transmitted to a mobile node.

[0026]

Thus, by creating the tunnel root according to a registration place change notice to the network repeating installation of the segment B which an external agent deserves from the node of a communications partner, when a mobile node carries out roaming, the communication link with a communications partner can be maintained. Since the communication link in this case is maintained by the tunnel root mentioned above, according to public relations by the network repeating installation of the segment of a migration place, the updating activity done about the routing table with which each network repeating installation was equipped does not need to be

converging it.
[0027]
[Embodiment of the Invention]
Hereafter, the operation gestalt of this invention is explained to a detail based on a drawing.
The 1st operation gestalt of IP network system in connection with this invention is shown in drawing 1 .
In IP network system shown in drawing 1 , the mobile node 210 has been moving to the segment B corresponding to the gateway router b shown in drawing 1 from the segment A corresponding to the gateway router a.
[0028]
In the mobile node 210 shown in drawing 1 , the communications control section 211 controlled the LAN interface (I/F) circuit 213 according to the directions from a user interface (I/F) 212, and is equipped with the function which addresses to the gateway router which exists in the segment connected, and multicasts a registration demand.
Moreover, in the gateway router b shown in drawing 1 , the LAN control section 222 receives the packet to the node which belongs to Segment B from the node which belongs the packet to the node which belongs to other segments from the node belonging to Segment B to delivery and other segments at the junction processing section 223 from the junction processing section 223, and sends it out to Segment B through the LAN interface circuitry 221 while it controls the data transfer in the interior of segment B through the LAN interface circuitry 221. Moreover, the junction processing section 223 shown in drawing 1 controls the WAN interface (I/F) circuit 225 based on the path information stored in routing table 224, and relays the exchange of the packet between WAN and Segment B.
[0029]
Moreover, in the gateway router b shown in drawing 1 , when a registration demand is received through the LAN interface circuitry 221, the registration processing section 226 sends out the respectively suitable directions for the port Management Department 227 and the path Research and Data Processing Department 228 so that it may mention later. The port Management Department 227 which showed drawing 1 operates the information about the physical port with which the gateway router b was equipped according to the directions from the registration processing section 226. Moreover, the path Research and Data Processing Department 228 which showed drawing 1 directs modification of path information to other gateway routers through the WAN interface circuitry 225 according to the directions from the registration processing section 226. Moreover, this path Research and Data Processing Department 228 updates the path information stored in routing table 224 according to the modification directions about the path information received through the directions from the registration processing section 226 or the WAN interface circuitry 225 mentioned above.
[0030]
Of course, other gateway routers a and c shown in drawing 1 are equipped with the same configuration as the gateway router b mentioned above.
Next, actuation of the mobile IP network system shown in drawing 1 is explained.
Drawing which explains actuation of a mobile IP network system to drawing 2 is shown.
Moreover, the explanatory view of the actuation which updates routing table to drawing 3 is shown.
[0031]
In addition, in drawing 2 and drawing 3 , it is Sign GWRa, and b and c about the gateway routers a, b, and c with Sign MN in a mobile node, and Sign CN shows the node of the communications partner of a mobile node, respectively.
When this mobile node 210 has moved to Segment B, as shown in drawing 2 , the communications control section 211 of the mobile node 210 shown in drawing 1 is addressed to the network device which has an external agent function, and multicasts the registration demand to this segment B. At this time, the communications control section 211 of the mobile node 210 creates the registration demand including the IP address given to self in the segment A which is a home network, and sends it out to Segment B through the LAN interface circuitry 213.

[0032]
The gateway router b which received this registration demand returns ACK which shows that the registration demand was received to the mobile node 210 of a requiring agency (refer to drawing 2), and waits for ACK from the mobile node 210 of a requiring agency.
The communications control section 211 of the mobile node 210 returns ACK to the gateway router (GWRb shown in drawing 2) of the transmitting origin of ACK which received first by the LAN interface circuitry 213, and returns NACK of a purport which refuses a response to the network device of a transmitting agency about ACK which received henceforth. If it does in this way, also when two or more gateway routers belong to Segment B, a mobile node can be registered as a subordinate of any one gateway router.
[0033]
According to ACK from the mobile node 210 mentioned above, the registration processing section 226 of the gateway router b shown in drawing 1 directs the purport which registers delivery and this IP address into the port Management Department 227 for the IP address included in the registration demand as the logical address of an own physical port. The port Management Department 227 performs suitable actuation for the information about the physical port with which the LAN interface circuitry 221 was equipped, and makes it function according to these directions as a node of the network which consists only of a mobile node 210 which mentioned above the physical port used as the candidate for actuation by this, and the original segment B.
[0034]
Subsequently, the registration processing section 226 shown in drawing 1 requests the purport which publicizes to delivery the IP address of the mobile node 210 mentioned above to the path Research and Data Processing Department 228, and publicizes this IP address to other gateway routers.
According to this request, the path Research and Data Processing Department 228 with which the gateway router b was equipped For example, general path information-interchange protocols, such as RIP (Routing Information Protocol) and OSPF (Open Shortest Path First), are followed. In WAN shown at network addresses 4.4.4.0/24 A 32-bit mask shows the IP address mentioned above as the host address of the mobile node 210, and it publicizes that this mobile node 210 was registered into the subordinate of the gateway router b (refer to drawing 2 and drawing 3).
[0035]
Subsequently, the path Research and Data Processing Department 228 with which the gateway router b was equipped registers into routing table 224 the information (direct) on a purport that the node which makes this the host address corresponding to the IP address (1.1.1.1/32) mentioned above exists in a subordinate's segment (refer to drawing 2 and drawing 3).
Moreover, while the path Research and Data Processing Department (not shown) with which the gateway router a and the gateway router c were equipped registers into routing table the host address (1.1.1.1/32) notified with the 32-bit mask by the public relations mentioned above as one of the network addresses used as the destination at this time, the IP address (4.4.4.2) of the gateway router b which is a publicizing agency as the destination corresponding to this destination is registered (refer to drawing 2 and drawing 3).
[0036]
Thus, renewal of the routing table with which each gateway router was equipped is completed. If the packet which makes the destination the mobile node 210 (sign MN of drawing 2) from the node CN belonging to the segment C corresponding to the gateway router c is sent out after that as shown in drawing 2 , as this packet is the following, it will be relayed to the mobile node 210.
[0037]
First, the junction processing section (not shown) with which the gateway router c was equipped performs routing processing about this packet based on the routing table in which information as shown in drawing 3 was stored (refer to drawing 2).
At this time, the junction processing section can be transmitted to the gateway router b corresponding to the segment B to which this mobile node 210 is carrying out the present group

of the packet which makes the mobile node 210 the destination by choosing the network address of the destination according to a RONGESUTOMATCHI algorithm (refer to drawing 2).
[0038]
It is because the junction processing section with which each gateway router was equipped since the IP address of a mobile node was registered as a network address with the 32-bit mask obtains the comparison result of the purport which was in agreement for a long time in the routing table with which each gateway router was equipped when it compares all the bit strings that show this network address and the IP address of the destination as mentioned above.
[0039]
Moreover, transfer [in / it judges that it is addressed to the node to which this packet belongs to its subordinate's segment based on the information for which the junction processing section 223 shown in drawing 1 when it did in this way and the packet addressed to mobile node 210 reached the gateway router b was stored in routing table 224, and this packet is passed to the LAN control section 222, and / Segment B] processing is presented.
[0040]
Thus, about the mobile node registered into the routing table with which each gateway router was equipped, routing of the packet can be carried out to the shortest path of resulting [from the node CN of a sending agency] in a mobile node, by determining the destination by host root routing, without going via the tunnel root formed of the home agent corresponding to a mobile node.
[0041]
This solves the problem of the triangular path by going via the tunnel root, and since the packet which makes a mobile node the destination can be transmitted through the shortest path, the user of a mobile node can be provided with the service which applied the application using a VoIP technique, and the application which distributes a video stream irrespective of whether a mobile node is in a home network, or it is in an external network.
[0042]
By the way, when the node CN of a sending agency exists in the home network of a mobile node, the node CN of a sending agency tends to require a MAC Address based on ARP on the assumption that a mobile node exists in the same segment as itself, and tends to perform a transfer of a packet within a segment. Since the response to the address demand based on ARP is not obtained though natural when the mobile node used as the destination is moving to other segments, it will become impossible however, for the node of a sending agency to transmit a packet to a mobile node.
[0043]
Next, how to transmit the packet from the node of the dispatch origin which exists in the home network of a mobile node to a mobile node is explained.
The 2nd operation gestalt of the mobile IP network system in connection with this invention is shown in drawing 4 .
In addition, about a thing equivalent to each part shown in drawing 1 among the components shown in drawing 4 , the sign shown in drawing 1 is attached and shown, and the explanation is omitted.
[0044]
The gateway router a shown in drawing 4 and the node CN of a sending agency belong to the segment A which is the home network to which the mobile node 210 originally belongs.
The vicarious execution processing section 229 is equipped with the function to answer a MAC Address demand instead of a mobile node as it mentions later, and to receive the packet addressed to a mobile node, in the gateway router a shown in drawing 4 .
[0045]
Drawing which explains actuation of a mobile IP network system to drawing 5 is shown.
In addition, in drawing 5 , it is Sign GWRa, and b and c about the gateway routers a, b, and c with Sign MN in a mobile node, and Sign CN shows the node of the communications partner of a mobile node, respectively.
The vicarious execution processing section 229 shown in drawing 4 returns the response

(PROXY ARP) containing an own MAC Address to the node CN of the dispatch origin of a demand to this address demand (ARP), when the address demand to the mobile node MN which is moving to the external network out of the address demand sent from the node CN of the dispatch origin belonging to Segment A is detected (refer to drawing 5). Then, the vicarious execution processing section 229 shown in drawing 4 receives the packet sent out to mobile node MN from the node CN of this dispatch origin instead of the mobile node MN (refer to drawing 5), and presents processing of the LAN control section 222 with the packet which received by making the mobile node MN into the destination anew.

[0046]

In this case, since the mobile node MN recognizes that current does not exist in Segment A, the junction processing which minds delivery and WAN for the packet received from the vicarious execution processing section 229 at the junction processing section 223 is presented with the LAN control section 222.

As drawing 5 was shown, registration processing which the mobile node mentioned above in the phase moved to Segment B is performed, and renewal of routing table is also completed. Therefore, when the junction processing section 223 with which the gateway router a was equipped performs routing processing based on the information stored in routing table 224, the packet of addressing to mobile node MN mentioned above is transmitted to the gateway router b corresponding to the segment b into which this mobile node MN is registered now, and the mobile node MN is reached further (refer to drawing 5).

[0047]

Thus, the packet sent out to a home network by making a mobile node into the destination from the node of the dispatch origin which exists in a home network can be transmitted to the mobile node registered into the external network by equipping the gateway router a which exists in the home network of a mobile node with the vicarious-execution processing section 229 which achieves the function receive the function and packet which answer an address demand instead of a mobile node according to the 2nd [in connection with this invention] mobile IP network system.

[0048]

By the way, when the mobile node is equipped with the radio function, a mobile node may move between segments to the midst which has received distribution of a music title and image software from the node CN of a communications partner.

Next, how to realize moving between segments while the mobile node equipped with the radio function had maintained the communication link, i.e., roaming, is explained.

[0049]

The operation gestalt of the 3rd [in connection with this invention] mobile IP network system is shown in drawing 6 .

In addition, about a thing equivalent to each part shown in drawing 1 among the components shown in drawing 6 , the sign shown in drawing 1 is attached and shown, and the explanation is omitted.

The mobile node 210 shown in drawing 6 was replaced with the LAN interface circuitry 213, and is equipped with the wireless LAN interface circuitry 231. Moreover, the gateway router b shown in drawing 6 is equipped with the wireless LAN interface 232. Of course, the gateway router b may be equipped with the LAN interface circuitry (not shown) of a cable.

[0050]

This mobile node 210 moves during a communication link with another node, and the communications control section 211 of the mobile node 210 shown in drawing 6 sends out the registration demand including the information on the purport which is communicating with the IP address of the node of a communications partner through the wireless LAN interface circuitry 231, when it advances into a segment which is different even in it.

In the gateway router b shown in drawing 6 , the registration processing section 226 directs sending out of delivery and a registration place change notice for the IP address of a mobile node in the notice processing section 233 with the IP address of the communications partner contained in this registration demand, when the information on the purport which is

communicating from the mobile node 210 to a registration demand is included. According to this, the notice processing section 233 creates the registration place change notice which shows that the segment into which the mobile node is registered changed using the IP address passed from the registration processing section 226, and sends out this registration place change notice to the LAN control section 222 as a packet which makes the node of a communications partner the destination.

[0051]

On the other hand, in the node CN of the communications partner shown in drawing 6 , the service processing section 214 is performing processing about distribution service of for example, image software, and sends out the packet containing the image data for distribution to a network through the communications control section 234. Moreover, in addition to the same function as the communications control section 211 shown in drawing 1 , the communications control section 234 shown in drawing 6 is equipped with the function for corresponding to the roaming of this node CN and the mobile node under communication link.

[0052]

The detail configuration of the function in connection with roaming processing is shown in drawing 7 .

In the node of the dispatch origin shown in drawing 7 , since it corresponds to the roaming of a mobile node, the communications control section 234 is equipped with the notice detecting element 238 which detects the registration place change notice mentioned above, the capsulation processing section 239 which encapsulates the packet to the mobile node 210 in connection with a registration place change notice, and the termination detecting element 240 which detects termination of the data distribution to a mobile node.

[0053]

Moreover, it sets in the junction processing section 223 with which the gateway router b shown in drawing 7 was equipped, and the packet junction control section 236 controls the exchange of the packet between Segments B and WAN which is not encapsulated. On the other hand, the capsule discharge section 235 shown in drawing 7 sends out the packet canceled and obtained [capsulation / reception and] in the packet encapsulated through the packet distribution section 237 to Segment B through the packet junction control section 236.

[0054]

Hereafter, actuation of the 3rd mobile IP network system shown in drawing 6 is explained. Drawing which explains actuation of the 3rd mobile IP network system to drawing 8 is shown. In addition, in drawing 8 , it is Sign GWRa, and b and c about the gateway routers a, b, and c with Sign MN in a mobile node, and Sign CN shows the node of the communications partner of a mobile node, respectively.

[0055]

For example, when the mobile node 210 shown in drawing 6 exists in the segment A which is a home network, as shown in drawing 8 , the packet of the node CN of the communications partner belonging to Segment C to addressing to mobile node MN is passed to GWRa by GWRc through WAN, and is further passed to the mobile node MN through this GWRa. When the mobile node MN moves to Segment B as it does not release the connection between the node CN of this communications partner, and the mobile node MN The communications control section 211 of the mobile node 210 shown in drawing 6 In addition to an own IP address, the registration demand including the information on the purport which is communicating with the IP address of a communications partner is created, and this registration demand is sent out to the gateway router b of Segment B through the wireless LAN interface circuitry 231 (refer to drawing 8).

[0056]

The registration processing section 226 of the gateway router b shown in drawing 6 according to this registration demand directs sending out of a registration place change notice in the notice processing section 233 shown in drawing 6 and drawing 7 while starting the processing for registering the mobile node 210 into Segment B. According to these directions, the notice processing section 233 creates a registration place change notice including the IP address of the mobile node 210, and the IP address of the gateway router b, and sends it out to the LAN

control section 222 as a packet which makes the node CN of a communications partner the destination.

[0057]

The packet containing such a registration place change notice is passed to the packet junction control section 236 with which the junction processing section 223 was equipped from the LAN control section 222. This packet junction control section 236 passes the packet containing the registration place change notice mentioned above to the WAN interface circuitry 225 based on the path information stored in routing table 224, and sends it out to the node CN of a communications partner through the gateway router c belonging to WAN and Segment C (refer to drawing 8).

[0058]

Thus, when the packet containing a registration place change notice reaches the LAN interface circuitry 213 of the node CN of a communications partner, the notice detecting element 238 with which the communications control section 234 shown in drawing 7 was equipped extracts the IP address of the mobile node 210 which is a communications partner, and the IP address of the gateway router b which achieves an external agent function in that registration place from a registration place change notice, notifies these IP addresses to the capsulation processing section 239, and starts this capsulation processing section 239. Whenever this capsulation processing section 239 receives the packet which makes the mobile node 210 the destination from the service processing section 214, it adds and encapsulates henceforth the header which includes the IP address of the gateway router b which is the new registration place of the mobile node 210 in this packet (refer to drawing 8), and passes this encapsulated packet (a capsulation packet is called hereafter) to the LAN interface circuitry 213.

[0059]

This capsulation packet is sent out to Segment C through the LAN interface circuitry 213 of the node CN of a communications partner, and is further passed to the gateway router c belonging to this segment C (refer to drawing 7 and drawing 8).

This capsulation packet is equipped with the header including the IP address of the gateway router b as mentioned above. Therefore, when the gateway router c performs the usual routing processing based on this header, this capsulation packet is transmitted to the gateway router b which is the migration place of the mobile node 210 through WAN (refer to drawing 8). **

When such a capsulation packet reaches the WAN interface circuitry 225 of the gateway router b, the packet distribution section 237 with which the junction processing section 223 shown in drawing 7 was equipped passes a capsulation packet to the capsule discharge section 235. This capsule discharge section 235 removes the header which includes an own IP address from a capsulation packet, and separates the packet addressed to mobile node 210.

[0060]

Thus, the packet of separated addressing to mobile node 210 is passed to the packet junction control section 236 by the packet distribution section 237 with the usual packet separated with the capsulation packet, and is passed to the mobile node 210 through the LAN control section 222 and the wireless LAN interface circuitry 232 (refer to drawing 8).

If it does in this way, the capsulation packet containing the packet sent out from the service processing section 214 with which Node CN was equipped can be passed to the mobile node 210 irrespective of whether it is being completed by the routing table in each gateway router via the tunnel root (half tone dot meshing is attached and shown in drawing 8) set up between Node CN and the gateway router b.

[0061]

While the mobile node 210 receives service of distribution of the image data from the node CN of a communications partner etc., in case it moves to other segments by this, a communication link condition required for distribution of data can be maintained.

Distribution of the capsulation packet which went via the tunnel root mentioned above is similarly repeated till termination of distribution of image data and music data for example, for distribution. In parallel to this, processing which updates routing table in each gateway router according to the processing and this which the gateway router b publicizes the IP address of the

mobile node 210 is performed according to the registration demand mentioned above.
[0062]
Therefore, when transmission of the stream which was under distribution when the mobile node 210 sent out the registration demand is completed, it can expect to already have converged the routing table with which each gateway router was equipped.
Therefore, the packet sent out to mobile node 210 from the service processing section 214 henceforth can be transmitted by the routing processing based on the convergent routing table according to the same procedure as the case where it is shown in drawing 3 .
[0063]
Here, the termination detecting element 240 shown in drawing 7 is equipped with the function to direct a halt of capsulation processing in the capsulation processing section 239, when the stream data inputted into the capsulation processing section 239 are supervised and the completion of distribution of stream data is detected. According to these directions, the capsulation processing section 239 passes the packet from the service processing section 214 to the LAN interface circuitry 213 as it is henceforth.
[0064]
If it does in this way, according to the completion of distribution of stream data, the tunnel root between Node CN and the gateway router b can be canceled, he can send out each packet which transmits henceforth to Segment C through the LAN interface circuitry 213, and you can leave it to the routing processing by the gateway router c (refer to drawing 8).
Moreover, if a procedure as shown in drawing 9 is used for example, it is also possible to cancel the tunnel root according to the completion of convergence of routing table.
[0065]
As shown in drawing 9 , the gateway router b which is the new registration place of the mobile node 210 transmits Ping which showed the IP address of the mobile node 210 as a sending agency to the node CN of a communications partner, when renewal of the own routing table 224 is completed.
If are being completed by the routing table with which the gateway router c corresponding to this node CN was equipped, and routing is carried out to the gateway router b corresponding to the segment B in which the mobile node 210 of a sending agency is carrying out the current group with the gateway router c and it is not converging, routing of the Ping returned from Node CN will be carried out to the gateway router corresponding to the segment to which the mobile node 210 belonged before.
[0066]
Therefore, it can judge whether the routing table with which the gateway router c corresponding to Node CN was equipped by whether the response to Ping to the node CN mentioned above comes on the contrary is converging the gateway router b.
As shown in drawing 9 , when routing of the response to Ping to the node CN mentioned above is carried out to the gateway router b by the gateway router c, it judges that convergence of the routing table with which the gateway router c was equipped has completed the gateway router b, and the packet which includes tunnel discharge directions in the node CN of a communications partner is sent out. In addition, although the destination of the response to Ping mentioned above is the mobile node 210, the gateway router b does not need to relay this response to the mobile node 210.
[0067]
On the other hand, the tunnel discharge directions sent out by the gateway router b are passed to Node CN through the gateway router c, and the communications control section 234 of Node CN suspends the processing which encapsulates the packet from the service processing section 214 according to this. Therefore, the packet containing the stream data under distribution is sent out to Segment C through the LAN interface circuitry 213 as it is, and the routing processing by the gateway router c is presented with it henceforth.
[0068]
The mobile IP network system of which the tunnel root is canceled with the application of such a procedure In for example, the junction processing section 223 of the gateway router (drawing 6

the gateway router b) of a segment with which the mobile node 210 is registered It has the convergence test section which performs the procedure mentioned above and judges the completion of convergence of routing table. Moreover, it replaces with the termination detecting element 240 shown in the communications control section 234 of the node of a communications partner at drawing 7 , and can realize by having the discharge directions reception section which directs a halt of capsulation processing according to reception of tunnel discharge directions.
[0069]

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the operation gestalt of the 1st [in connection with this invention] mobile IP network system.
[Drawing 2] It is drawing explaining actuation of the 1st mobile IP network system.
[Drawing 3] It is drawing explaining the actuation which updates routing table.
[Drawing 4] It is drawing showing the operation gestalt of the 2nd [in connection with this invention] mobile IP network system.
[Drawing 5] It is drawing explaining actuation of the 2nd mobile IP network system.
[Drawing 6] It is drawing showing the operation gestalt of the 3rd [in connection with this invention] mobile IP network system.
[Drawing 7] It is drawing showing the detail configuration of the function in connection with roaming processing.
[Drawing 8] It is drawing explaining actuation of the 3rd mobile IP network system.
[Drawing 9] It is drawing explaining another actuation of the 3rd mobile IP network system.
[Drawing 10] It is drawing explaining IP network system.
[Drawing 11] It is drawing explaining a mobile IP network system.
[Description of Notations]
210 Mobile Node
211 234 Communications control section
212 User Interface (I/F)
213 221 LAN interface (I/F) circuit
221 LAN Interface Circuitry
222 LAN Control Section
223 Junction Processing Section
224 Routing Table
225 WAN Interface (I/F) Circuit
226 Registration Processing Section
227 Port Management Department
228 Path Research and Data Processing Department
229 Vicarious Execution Processing Section
231 232 Wireless LAN interface circuitry
233 Notice Processing Section
235 Capsule Discharge Section
236 Packet Junction Control Section
237 Packet Distribution Section
238 Notice Detecting Element
239 Capsulation Processing Section
240 Termination Detecting Element

[Translation done.]

(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2005-6264
(P2005-6264A)
(43)公開日　平成17年1月6日(2005.1.6)

(51)Int.Cl.[7]	F I	テーマコード（参考）
H04L 12/56	H04L 12/56 100D	5K030

審査請求 未請求　請求項の数 3　OL　（全 19 頁）

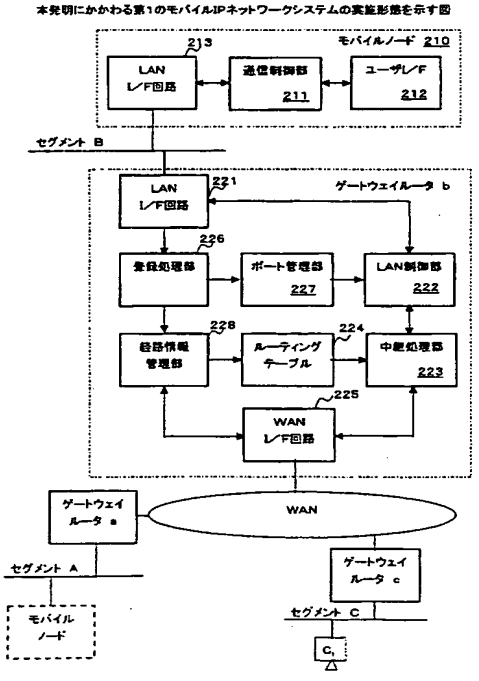
(21)出願番号　特願2003-170610(P2003-170610)
(22)出願日　平成15年6月16日(2003.6.16)

(71)出願人　000005223
富士通株式会社
神奈川県川崎市中原区上小田中４丁目１番１号
(74)代理人　100072718
弁理士　古谷　史旺
(72)発明者　原　俊英
神奈川県川崎市中原区上小田中４丁目１番１号　富士通株式会社内
(72)発明者　前田　孝英
神奈川県川崎市中原区上小田中４丁目１番１号　富士通株式会社内

Ｆターム(参考)　5K030 HA08 HB28 HC09 HD03 JT01 JT02 JT09 KA05 LB05

(54)【発明の名称】モバイルＩＰネットワークシステム

(57)【要約】
【課題】モバイルＩＰネットワークにおいて、モバイルノードとその通信相手のノードとの間で最適な経路を利用した通信を実現する。
【解決手段】モバイルノードは、移動先のセグメントネットワーク中継装置に対して自身のＩＰアドレスのそのセグメントへの登録を依頼する登録依頼手段を備え、複数のセグメントに備えられたネットワーク中継装置それぞれにおいて、登録手段は、モバイルノードからの依頼に応じて、自身のポートの論理アドレスとしてモバイルノードのホストアドレスを登録し、広報手段は、このモバイルノードのホストアドレスを他のネットワーク中継装置に広報し、テーブル更新手段は、広報されたホストアドレスと広報元のネットワーク中継装置のネットワークアドレスをルーティングテーブルに登録し、ルーティング手段は、このルーティングテーブルに基づいて、配下のノードからのパケットをルーティングする。
【選択図】　図１



【特許請求の範囲】
【請求項１】
モバイルノードを含む複数のノードが登録されたセグメントが複数存在し、これらのセグメントは、それぞれに備えられたネットワーク中継装置を介して互いに結合されているモバイルＩＰネットワークシステムにおいて、
前記モバイルノードは、移動先のセグメントにおいて、自身のＩＰアドレスをそのセグメントに登録する旨をそのセグメントに備えられた前記ネットワーク中継装置に依頼する登録依頼手段を備え、
前記複数のセグメントに備えられた前記ネットワーク中継装置それぞれは、
前記モバイルノードからの依頼に応じて、自身のポートの論理アドレスとして前記モバイルノードのホストアドレスを登録する登録手段と、
前記モバイルノードからの依頼に応じて、前記モバイルノードのホストアドレスを他の前記ネットワーク中継装置に広報する広報手段と、
前記他のネットワーク中継装置によって広報されたホストアドレスを宛先のネットワークアドレスの一つとして登録するとともに、これに対応する転送先として前記広報元のネットワーク中継装置のネットワークアドレスをルーティングテーブルに登録するテーブル更新手段と、
配下のノードが宛先として指定したホストアドレスに一致するネットワークアドレスがルーティングテーブルに存在する場合に、このホストアドレスに対応して登録されたネットワークアドレスで示されるネットワーク中継装置にデータを転送するルーティング手段とを備える
ことを特徴とするモバイルＩＰネットワークシステム。
【請求項２】
請求項１に記載のモバイルＩＰネットワークシステムにおいて、
前記ネットワーク中継装置は、
配下のセグメントに存在するノードから他のセグメントに移動しているモバイルノードに対するアドレス検出要求を受信したときに、前記モバイルノードに代わって自身のＭＡＣアドレスを含む応答を返す代理返信手段と、
前記アドレス検出要求の発信元のノードから送出されたパケットを前記モバイルノードに代わって受信する受信代行手段と、
前記受信代行手段が受信したパケットを、前記モバイルノードを宛先として改めて前記ルーティング手段に渡して再送信する再送信手段とを備える
ことを特徴とするモバイルＩＰネットワークシステム。
【請求項３】
請求項１に記載のモバイルＩＰネットワークシステムにおいて、
前記モバイルノードは、
ＩＰネットワークにおいてやり取りされる情報を無線信号として送受信する無線通信手段と、
通信中である場合に、通信相手のノードのＩＰアドレスを含む登録要求を前記無線通信手段を介して移動先のセグメントに属するネットワーク中継装置に通知する通知手段とを備え、
前記ネットワーク中継装置は、
ＩＰネットワークにおいてやり取りされる情報を無線信号として送受信する無線通信手段と、
前記ネットワーク中継装置を宛先とする旨のヘッダを用いてカプセル化されたパケットのカプセル化を解除して、配下のセグメントに属するノードに送信するカプセル解除手段とを備え、
前記ネットワーク中継装置の登録手段は、
前記無線通信手段を介して受け取った登録要求に含まれている通信相手のノードのＩＰアドレスを検出する通信相手検出手段と、

前記通信相手検出手段によって検出されたＩＰアドレスで示される前記通信相手のノードに、前記登録要求による登録の対象となるモバイルノードのＩＰアドレスと前記モバイルノードの登録先である前記ネットワーク中継装置のＩＰアドレスとを含む登録先変更通知を送信する変更通知手段とを備え、
前記通信相手のノードは、
通信中のモバイルノードのＩＰアドレスを含む登録先変更通知を検出する変更通知検出手段と、
前記登録先変更通知の検出に応じて、通信中のモバイルノードを宛先とするパケットに前記モバイルノードの登録先であるネットワーク中継装置を宛先とするヘッダを付加することによってカプセル化して送出するカプセル化手段とを備える
ことを特徴とするモバイルＩＰネットワークシステム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】

本発明は、モバイルＩＰネットワークシステムに関し、特に、モバイルＩＰネットワークにおけるルーティング技術に関する。
社内の各部署においてＬＡＮ技術を用いて構築された単位ネットワークであるセグメントをＷＡＮによって接続したＩＰネットワークシステムなどでは、ＷＡＮによって結合された各セグメントには、ノートパソコンのような移動可能な端末が含まれている場合が多い。このようなモバイルノード（Ｍｏｂｉｌｅ　Ｎｏｄｅ：ＭＮ）にも、固定の端末と同じように、その端末が属するセグメント、つまり、ホームネットワークにおいてそれぞれＩＰアドレスが割り当てられている。

【０００２】

このようにモバイルノードに付与されたＩＰアドレスを移動先の外部ネットワークにおいても利用可能とする仕組みを備えたＩＰネットワークシステムを、本明細書においてモバイルＩＰネットワークシステムと称する。

【０００３】

【従来の技術】

図１０に、ＩＰネットワークシステムを説明する図を示す。
図１０において、ネットワークアドレス１．１．１．０／２４で示されるセグメントＡと、ネットワークアドレス２．２．２．０／２４で示されるセグメントＢと、ネットワークアドレス３．３．３．０／２４で示されるセグメントＣとは、それぞれゲートウェイルータＡ、Ｂ、Ｃを備えており、これらのゲートウェイルータＡ、Ｂ、Ｃ（図１０において、それぞれ符号ＧＷＲａ、ｂ、ｃを付して示す）を介して、上述した３つのセグメントＡ、Ｂ、Ｃは、ネットワークアドレス４．４．４．０／２４で示されるＷＡＮに接続されている。

【０００４】

図１０に示したゲートウェイルータＡ、Ｂ、Ｃは、ＷＡＮとＬＡＮのように異なる種類のネットワークの接続点に配置されたネットワーク中継装置であり、ＷＡＮとＬＡＮにおけるセグメントとの間のデータ伝送を中継するゲートウェイ機能と、セグメント内でのデータの中継を行うルータ機能とを兼ね備えたネットワーク機器である。

【０００５】

このような構成のＩＰネットワークでは、ＷＡＮを経由するセグメント間の通信では、各ゲートウェイルータに備えられたルーティングテーブルに基づいてネットワーク単位のルーティングを行い、セグメント内でのデータの転送は、ＭＡＣアドレスに基づくフォワーディングを行っている。
例えば、図１０に示したセグメントＣに属するノード$Ｃ_1$からセグメントＡに属するノード$Ａ_1$を示すＩＰアドレス（例えば、１．１．１．１）を宛先としてパケットが送出されると、セグメントＣに備えられたゲートウェイルータＣは、このＩＰアドレスとルーティングテーブルに登録されているネットワークアドレスとを比較し、もっとも長く一致した

ネットワークアドレスに対応する転送先（図１０において、Ｎｅｘｔ　Ｈｏｐとして示す）にパケットを転送する。図１０に示した例では、ネットワークアドレス１．１．１．０／２４が宛先のＩＰアドレスに最も近いので、ゲートウェイルータＣは、このネットワークアドレスに対応してルーティングテーブルに登録された転送先、つまり、ＩＰアドレス４．４．４．１で示されるゲートウェイルータＡにパケットを転送する。このパケットを受け取ったゲートウェイルータＡは、ＡＲＰ（Ａｄｄｒｅｓｓ　Ｒｅｓｏｌｕｔｉｏｎ　Ｐｒｏｔｏｃｏｌ）に基づいて、パケットの宛先として指定されたＩＰアドレスに対応するＭＡＣアドレスを探し出し、最終的に、このＭＡＣアドレスを持つノード$Ａ_1$にパケットを渡す。

【０００６】

ところで、セグメントＡに属するノード$Ａ_1$がモバイルノード（以下、モバイルノードと称する）である場合には、当然ながら、このモバイルノードＭＮがホームネットワークであるセグメントＡを離れて別のセグメント（例えば、セグメントＢ）に移動することが考えられる。このような場合に、このモバイルノードＭＮにホームネットワーク（つまり、セグメントＡ）において与えられたＩＰアドレスをそのまま外部ネットワークであるセグメントＢにおいても利用可能とすれば、移動するたびの設定の変更などが不要となるので、モバイルノードの機動性を発揮させることができる。

【０００７】

また、セグメント内のサーバにアクセスすることができるＩＰアドレスをそのセグメントに属する端末に与えられたＩＰアドレスに制限することによって、セキュリティを確保している場合には、モバイルノードが外部ネットワークにおいても、ホームネットワークで与えられたＩＰアドレスを維持することを可能とすれば、モバイルノードの利用者は、他のセグメントに接続しているときに、ホームネットワークにいるときと同様にサーバを利用することができる。

【０００８】

次に、モバイルノードにホームネットワークにおいて与えられたＩＰアドレスを外部ネットワークにおいて利用可能とする技術について説明する。

図１１に、モバイルＩＰネットワークシステムを説明する図を示す。なお、図１１に示す構成要素のうち、図１０に示した各部と同等のものについては、図１０に示した符号を付して示し、その説明を省略する。

【０００９】

例えば、図１１に示したセグメントＡに属するモバイルノードＭＮが、セグメントＢに移動した場合に、モバイルノードＭＮは、セグメントＢにおいて外部エージェント（ＦＡ）機能を果たすゲートウェイルータＢに位置情報の登録を要求する。これに応じて、このゲートウェイルータＢは、モバイルノードＭＮを配下のセグメントに属する端末として登録するとともに、モバイルノードＭＮのホームネットワーク（この場合は、セグメントＡ）においてホームエージェント（ＨＡ）機能を果たすゲートウェイルータＡに、モバイルノードＭＮから受け取った位置情報を通知する。この通知を受け取ったゲートウェイルータＡは、上述したルーティングテーブルとは別に、通知された位置情報に基づいて、モバイルノードＭＮ用の転送テーブルを作成し、モバイルノードＭＮに与えたＩＰアドレス（例えば、１．１．１．１）に対応して外部エージェントＦＡのＩＰアドレス（例えば、４．４．４．２）を登録する。

【００１０】

このようにして、ホームエージェントＨＡと外部エージェントＦＡとがモバイルノードの現在位置を管理する方式では、各ゲートウェイルータＡ、Ｂ、Ｃのルーティングテーブルは全く変更されない。したがって、例えば、図１１に示したセグメントＣに属するノード$Ｃ_1$からモバイルノードＭＮを宛先として送信されたパケットは、ゲートウェイルータＣにより、ホームエージェントＨＡであるゲートウェイルータＡに転送される（図１１に符号（１）を付して示す）。このとき、ホームエージェントＨＡは、モバイルノードＭＮに代わって上述したパケットを一旦受け取り、その後、図１１において符号（２）を付して

示すように、上述した転送テーブルに登録された外部エージェントＦＡのＩＰアドレスを含むヘッダを付加して、このパケットをカプセル化した上で、外部エージェントＦＡに転送する。このようにカプセル化されたパケットは、図１１において符号（３）を付して示すように、外部エージェントＦＡにおいてカプセル化が解除された後に、本来の宛先であるモバイルノードＭＮに渡される。

【００１１】

なお、図１１に示したようなモバイルＩＰネットワークシステムに関する詳細は、例えば、非特許文献１を参照されたい。

【非特許文献１】

Ｃ．Ｐｅｒｋｉｎｓ，Ｅｄ．Ｎｏｋｉａ Ｒｅｓｅａｒｃｈ Ｃｅｎｔｅｒ ”ＩＰ Ｍｏｂｉｌｉｔｙ Ｓｕｐｐｏｒｔ ｆｏｒ Ｉｐｖ４” Ａｕｇｕｓｔ ２００２ Ｎｅｔｗｏｒｋ Ｗｏｒｋｉｎｇ Ｇｒｏｕｐ Ｒｅｑｕｅｓｔ ｆｏｒ Ｃｏｍｍｅｎｔｓ： ３３４４

【００１２】

【発明が解決しようとする課題】

このように、従来のモバイルＩＰネットワークシステムでは、宛先のモバイルノードが現在属しているセグメントにかかわらず、発信元のノード（図１１において符号ＣＮを付して示す）からのパケットを、モバイルノードのホームネットワークに備えられたホームエージェントＨＡによって作成したトンネルルートを経由して外部エージェントＦＡに転送している。

したがって、上述した従来のモバイルＩＰネットワークシステムでは、モバイルノードＭＮが外部ネットワークＦＮに移動している場合に発信元のノードによって送出されたパケットの伝送経路は、当然ながら、モバイルノードＭＮがホームネットワークＨＮに存在する場合に比べて大幅に長くなり、伝送経路長の増大とともに伝送遅延も増大してしまう。また、上述したような発信元のノードＣＮからホームエージェントＨＡを経由して外部エージェントＦＡに至るいわゆる三角経路の途中に帯域の狭い経路が存在すると、この経路の通信速度はわずかなトラフィックの増大によって大幅に劣化し、更なる伝送遅延を招いてしまう。そして、伝送遅延の増大は、例えば、ＶｏＩＰ技術に基づくアプリケーションやビデオストリームを配信するアプリケーションなどをモバイルＩＰネットワークシステムにおいて実現する上で、非常に大きな障害となる。

【００１３】

また、図１１に示したようなトンネルルートを経由してパケットを転送するためには、ホームエージェントＨＡにおけるカプセル化処理が必要不可欠となり、ホームエージェント機能を果たすゲートウェイルータの処理負担が大きくなる。特に、ＶｏＩＰ技術に基づくアプリケーションやビデオストリームを配信するアプリケーションなどでは、発信元のノードＣＮから膨大な数のパケットが送出されるので、これらのパケットを滞りなくカプセル化するためにはホームエージェントＨＡに極めて高い処理能力が要求される。

【００１４】

更に、ホームエージェントＨＡにおけるカプセル化処理によって、一つ一つのパケットサイズが増大し、データ転送効率が低下することも課題の一つである。特に、ＶｏＩＰでは、各パケットに格納されるペイロードが元もとのヘッダの長さに比べてさえ短いので、カプセル化によるデータ転送効率の低下は深刻である。例えば、ＩＴＵ－Ｔによる勧告Ｇ．７２９に従う音声コーデックを利用する場合に、各パケットに格納されるペイロードは２０バイトあるいは４０バイトであるのに対して、ＭＡＣヘッダ、ＩＰヘッダ、ＵＤＰヘッダおよびＲＴＰヘッダを含む元もとのヘッダの長さは７８バイトに上るため、データ転送効率は、ペイロードが４０バイトの場合でさえ０．４０８であり、ペイロードが２０バイトの場合に至っては０．２５６となる。もちろん、上述したカプセル化処理によって、外部エージェントＦＡのＩＰアドレスを含むＩＰヘッダが付加されれば、当然ながら、更にデータ転送効率は低下する。

【００１５】

本発明は、モバイルＩＰネットワークにおいて、モバイルノードとその通信相手のノードとの間で最適な経路を利用した通信を実現するＩＰネットワークシステムを提供することを目的とする。

【００１６】

【課題を解決するための手段】

本発明にかかわる第１のモバイルＩＰネットワークシステムは、モバイルノードに備えられる登録依頼手段と、ネットワーク中継装置に備えられる登録手段、広報手段、テーブル更新手段およびルーティング手段とから構成される。

本発明にかかわる第１のモバイルＩＰネットワークシステムの原理は、以下の通りである。

モバイルＩＰネットワークシステムは、モバイルノードを含む複数のノードが登録されたセグメントが複数存在し、これらのセグメントは、それぞれに備えられたネットワーク中継装置を介して互いに結合されている。つまり、これらのネットワーク中継装置は、各セグメントとこれらのセグメントをつなぐ別のネットワークとの接続点に配置され、この別のネットワークと各セグメントとの間のパケットの授受を中継する機能を果たしている。また、モバイルノードにおいて、登録依頼手段は、移動先のセグメントにおいて、自身のＩＰアドレスをそのセグメントに登録する旨をそのセグメントに備えられたネットワーク中継装置に依頼する。一方、複数のセグメントに備えられたネットワーク中継装置それぞれにおいて、登録手段は、モバイルノードからの依頼に応じて、自身のポートの論理アドレスとしてモバイルノードのホストアドレスを登録する。ネットワーク中継装置それぞれに備えられる広報手段は、モバイルノードからの依頼に応じて、モバイルノードのホストアドレスを他のネットワーク中継装置に広報する。ネットワーク中継装置それぞれに備えられるテーブル更新手段は、他のネットワーク中継装置によって広報されたホストアドレスを宛先のネットワークアドレスの一つとして登録するとともに、これに対応する転送先として広報元のネットワーク中継装置のネットワークアドレスをルーティングテーブルに登録する。ネットワーク中継装置それぞれに備えられるルーティング手段は、配下のノードが宛先として指定したホストアドレスに一致するネットワークアドレスがルーティングテーブルに存在する場合に、このホストアドレスに対応して登録されたネットワークアドレスで示されるネットワーク中継装置にデータを転送する。

【００１７】

このように構成された第１のモバイルＩＰネットワークシステムの動作は、下記の通りである。

モバイルノードがホームネットワークであるセグメントＡから離れて別のセグメントＢに移動したときに、移動先のセグメントＢのネットワーク中継装置は、このモバイルノードに備えられた登録依頼手段から登録依頼を受けて、そのネットワーク中継装置のポートの論理アドレスとして、登録依頼で示されたモバイルノードのホストアドレスを登録する。これにより、ネットワーク中継装置の物理ポートは、本来のセグメントＢとこのモバイルノードのみからなる別のネットワークに接続点として機能する。その後、登録依頼を受けたネットワーク中継装置の広報手段は、このホストアドレスで示されるノードを自身の配下のノードとして他のネットワーク中継装置に広報し、これらのネットワーク中継装置に供えられたテーブル更新手段を介してルーティングテーブルにこのホストアドレスと移動先のネットワーク中継装置に対応するネットワークアドレスとの関係を反映する。したがって、その後、他のセグメントＣに属するノードが、上述したセグメントＢに移動したモバイルノードを宛先とするパケットを発信したときに、このセグメントＣに対応するネットワーク中継装置に備えられたルーティング手段は、上述したようにして更新されたルーティングテーブルに基づいて、モバイルノードのホストアドレスに対応付けられたネットワークアドレスで示されるネットワーク中継装置、すなわち、モバイルノードの移動先のネットワークに対応するネットワーク中継装置に上述したパケットを転送する。

【００１８】

つまり、上述した第１のモバイルＩＰネットワークシステムでは、モバイルノードの移動

先にかかわらず、発信元のノードからのパケットを、モバイルノードの移動先のネットワークに属するネットワーク中継装置に直接に転送することができる。この場合に、従来のようなトンネルルートは形成されないので、当然ながら、カプセル化もまた不要である。

【００１９】

本発明にかかわる第２のモバイルＩＰネットワークシステムは、上述した第１のモバイルＩＰネットワークシステムにおいて、ネットワーク中継装置に代理返信手段と受信代行手段と再送信手段とを備えて構成される。

本発明にかかわる第２のモバイルＩＰネットワークシステムの原理は、以下の通りである。

【００２０】

上述した第１のモバイルＩＰネットワークシステムのネットワーク中継装置において、代理返信手段は、配下のセグメントに存在するノードから他のセグメントに移動しているモバイルノードに対するアドレス検出要求を受信したときに、モバイルノードに代わって自身のＭＡＣアドレスを含む応答を返す。受信代行手段は、アドレス検出要求の発信元のノードから送出されたパケットをモバイルノードに代わって受信する。再送信手段は、受信代行手段が受信したパケットを、モバイルノードを宛先として改めてルーティング手段に渡して再送信する。

【００２１】

このように構成された第２のモバイルＩＰネットワークシステムの動作は、下記の通りである。

他のセグメントに移動しているモバイルノードに関するアドレス検出要求を検出したときに、ネットワーク中継装置の代理返信手段は、自身のＭＡＣアドレスをアドレス検出要求の発信元のノードに返し、このノードから送信されるパケットを受信代行手段により受信する。このようにして受信代行手段が受信したパケットは、再送信手段により、本来の宛先であるモバイルノードを宛先とするヘッダを付加した上でルーティング手段に渡され、このモバイルノードに宛てて再送信される。

【００２２】

このように、第２のモバイルＩＰネットワークシステムでは、モバイルノードが本来属しているホームネットワークに属するネットワーク中継装置が、同じセグメントに属するノードからのアドレス検出要求に対する応答およびパケットの受信を代行し、受信したパケットをルーティング手段による中継処理に供することにより、移動したモバイルノードと同一のネットワークアドレスを持つノードがモバイルノードと通信しようとした場合の不具合を解消することができる。

【００２３】

この場合に、発信元のノードが送信したパケットは、一旦ネットワーク中継装置の受信代行手段によって受信され、再送信手段によって改めて送信されているので、このパケットを転送するためのトンネルルートは形成されない。したがって、当然ながら、カプセル化も不要である。

本発明にかかわる第３のモバイルＩＰネットワークシステムは、上述した第１のモバイルＩＰネットワークシステムにおいて、モバイルノードに、無線通信手段および通知手段を備え、ネットワーク中継装置に、無線通信手段およびカプセル解除手段を備えるとともに、ネットワーク中継装置に備えられる登録手段に、通信相手検出手段と変更通知手段とを備え、通信相手のノードに、通知検出手段とカプセル化手段とを備えて構成される。

【００２４】

本発明にかかわる第３のモバイルＩＰネットワークシステムの原理は、以下の通りである。

上述した第１のモバイルＩＰネットワークシステムのモバイルノードにおいて、無線通信手段は、ＩＰネットワークにおいてやり取りされる情報を無線信号として送受信する。モバイルノードに備えられる通知手段は、通信中である場合に、通信相手のノードのＩＰアドレスを含む登録要求を無線通信手段を介して移動先のセグメントに属するネットワーク

中継装置に通知する。また、ネットワーク中継装置において、無線通信手段は、ＩＰネットワークにおいてやり取りされる情報を無線信号として送受信する。カプセル解除手段は、ネットワーク中継装置を宛先とする旨のヘッダを用いてカプセル化されたパケットのカプセル化を解除して、配下のセグメントに属するノードに送信する。また、ネットワーク中継装置に備えられた登録手段において、通信相手検出手段は、無線通信手段を介して受け取った登録要求に含まれている通信相手のノードのＩＰアドレスを検出する。変更通知手段は、通信相手検出手段によって検出されたＩＰアドレスで示される通信相手のノードに、登録要求による登録の対象となるモバイルノードのＩＰアドレスとモバイルノードの登録先であるネットワーク中継装置のＩＰアドレスとを含む登録先変更通知を送信する。また、通信相手のノードにおいて、変更通知検出手段は、通信中のモバイルノードのＩＰアドレスを含む登録先変更通知を検出する。カプセル化手段は、登録先変更通知の検出に応じて、通信中のモバイルノードを宛先とするパケットにモバイルノードの登録先であるネットワーク中継装置を宛先とするヘッダを付加することによってカプセル化して送出する。

【００２５】

このように構成された第３のモバイルＩＰネットワークシステムの動作は、下記の通りである。

例えば、セグメントＡをホームネットワークとするモバイルノードが通信相手のノードとの通信状態を維持したまま移動し、それまでとは異なるセグメントＢに対応するエリアに入り、セグメントＢのノードとして登録された後に、モバイルノードに備えられた通知手段は、通信相手のノードを宛先として、モバイルノードのＩＰアドレスとセグメントＢのネットワーク中継装置を示すネットワークアドレスとを含む登録先変更通知を送出する。一方、通信相手のノードにおいて、変更通知検出手段によってこの登録先変更通知が検出されると、以降にモバイルノードに宛てて送出するパケットは、カプセル化手段によって、セグメントＢのネットワーク中継装置を示すネットワークアドレスを含むヘッダを用いてカプセル化されて送出される。そして、このようにカプセル化されたパケットは、モバイルノードの移動先であるセグメントＢのネットワーク中継装置に備えられたカプセル解除手段によって解除され、モバイルノードに転送される。

【００２６】

このように、登録先変更通知に応じて、通信相手のノードから外部エージェントに相当するセグメントＢのネットワーク中継装置にトンネルルートを作成することにより、モバイルノードがローミングする場合においても、通信相手との通信を維持することができる。この場合の通信は、上述したトンネルルートによって維持されるので、移動先のセグメントのネットワーク中継装置による広報に応じて、各ネットワーク中継装置に備えられたルーティングテーブルについて行われる更新作業が収束している必要はない。

【００２７】

【発明の実施の形態】

以下、図面に基づいて、本発明の実施形態について詳細に説明する。

図１に、本発明にかかわるＩＰネットワークシステムの第１の実施形態を示す。

図１に示したＩＰネットワークシステムにおいて、モバイルノード２１０は、ゲートウェイルータａに対応するセグメントＡから、図１に示したゲートウェイルータｂに対応するセグメントＢに移動してきている。

【００２８】

図１に示したモバイルノード２１０において、通信制御部２１１は、例えば、ユーザインタフェース（Ｉ／Ｆ）２１２からの指示に応じてＬＡＮインタフェース（Ｉ／Ｆ）回路２１３を制御し、接続されているセグメントに存在するゲートウェイルータに宛てて登録要求をマルチキャストする機能を備えている。

また、図１に示したゲートウェイルータｂにおいて、ＬＡＮ制御部２２２は、ＬＡＮインタフェース回路２２１を介してセグメントＢ内部におけるデータ転送を制御するとともに、セグメントＢに属するノードから他のセグメントに属するノードへのパケットを中継処

理部２２３に渡し、また、他のセグメントに属するノードからセグメントＢに属するノードへのパケットを中継処理部２２３から受け取ってＬＡＮインタフェース回路２２１を介してセグメントＢに送出する。また、図１に示した中継処理部２２３は、ルーティングテーブル２２４に格納された経路情報に基づいてＷＡＮインタフェース（Ｉ／Ｆ）回路２２５を制御し、ＷＡＮとセグメントＢとの間のパケットのやり取りを中継する。

【００２９】

また、図１に示したゲートウェイルータｂにおいて、登録処理部２２６は、ＬＡＮインタフェース回路２２１を介して登録要求を受け取ったときに、後述するように、ポート管理部２２７および経路情報管理部２２８にそれぞれ適切な指示を送出する。図１に示したポート管理部２２７は、登録処理部２２６からの指示に応じて、ゲートウェイルータｂに備えられた物理ポートに関する情報を操作する。また、図１に示した経路情報管理部２２８は、登録処理部２２６からの指示に応じて、ＷＡＮインタフェース回路２２５を介して他のゲートウェイルータに経路情報の変更を指示する。また、この経路情報管理部２２８は、上述した登録処理部２２６からの指示あるいはＷＡＮインタフェース回路２２５を介して受け取った経路情報に関する変更指示に応じて、ルーティングテーブル２２４に格納された経路情報を更新する。

【００３０】

もちろん、図１に示した他のゲートウェイルータａ、ｃも、上述したゲートウェイルータｂと同様の構成を備えている。

次に、図１に示したモバイルＩＰネットワークシステムの動作について説明する。

図２に、モバイルＩＰネットワークシステムの動作を説明する図を示す。また、図３に、ルーティングテーブルを更新する動作の説明図を示す。

【００３１】

なお、図２および図３において、モバイルノードを符号ＭＮで、ゲートウェイルータａ、ｂ、ｃを符号ＧＷＲａ、ｂ、ｃで、そして、モバイルノードの通信相手のノードを符号ＣＮでそれぞれ示す。

図１に示したモバイルノード２１０の通信制御部２１１は、例えば、このモバイルノード２１０がセグメントＢに移動してきたときに、図２に示すように、外部エージェント機能を有するネットワーク機器に宛ててこのセグメントＢへの登録要求をマルチキャストする。このとき、モバイルノード２１０の通信制御部２１１は、ホームネットワークであるセグメントＡにおいて自身に与えられたＩＰアドレスを含む登録要求を作成し、ＬＡＮインタフェース回路２１３を介してセグメントＢに送出する。

【００３２】

この登録要求を受け取ったゲートウェイルータｂは、要求元のモバイルノード２１０に登録要求を受け取ったことを示すＡＣＫを返し（図２参照）、要求元のモバイルノード２１０からのＡＣＫを待つ。

モバイルノード２１０の通信制御部２１１は、ＬＡＮインタフェース回路２１３によって最初に受信したＡＣＫの送信元のゲートウェイルータ（図２に示したＧＷＲｂ）にＡＣＫを返し、以降に受信したＡＣＫについては、送信元のネットワーク機器に応答を拒絶する旨のＮＡＣＫを返す。このようにすれば、セグメントＢに複数のゲートウェイルータが属している場合にも、いずれか一つのゲートウェイルータの配下としてモバイルノードを登録することができる。

【００３３】

上述したモバイルノード２１０からのＡＣＫに応じて、図１に示したゲートウェイルータｂの登録処理部２２６は、登録要求に含まれているＩＰアドレスをポート管理部２２７に渡し、このＩＰアドレスを自身の物理ポートの論理アドレスとして登録する旨を指示する。この指示に応じて、ポート管理部２２７は、ＬＡＮインタフェース回路２２１に備えられた物理ポートに関する情報に適切な操作を実行し、これにより、操作対象となった物理ポートを、上述したモバイルノード２１０のみからなるネットワークと本来のセグメントＢとの接続点として機能させる。

【００３４】
次いで、図１に示した登録処理部２２６は、経路情報管理部２２８に上述したモバイルノード２１０のＩＰアドレスを渡し、このＩＰアドレスを他のゲートウェイルータに広報する旨を依頼する。
この依頼に応じて、ゲートウェイルータｂに備えられた経路情報管理部２２８は、例えば、ＲＩＰ（Ｒｏｕｔｉｎｇ Ｉｎｆｏｒｍａｔｉｏｎ Ｐｒｏｔｏｃｏｌ）やＯＳＰＦ（Ｏｐｅｎ Ｓｈｏｒｔｅｓｔ Ｐａｔｈ Ｆｉｒｓｔ）などの一般的な経路情報交換プロトコルに従って、ネットワークアドレス４．４．４．０／２４で示されるＷＡＮにおいて、上述したＩＰアドレスをモバイルノード２１０のホストアドレスとして３２ビットマスクで示し、このモバイルノード２１０がゲートウェイルータｂの配下に登録されたことを広報する（図２および図３参照）。
【００３５】
次いで、ゲートウェイルータｂに備えられた経路情報管理部２２８は、上述したＩＰアドレス（１．１．１．１／３２）に対応してこれをホストアドレスとするノードが配下のセグメントに存在する旨の情報（ｄｉｒｅｃｔ）をルーティングテーブル２２４に登録する（図２および図３参照）。
またこのとき、ゲートウェイルータａおよびゲートウェイルータｃに備えられた経路情報管理部（図示せず）は、上述した広報によって３２ビットマスクで通知されたホストアドレス（１．１．１．１／３２）を宛先となるネットワークアドレスの一つとしてルーティングテーブルに登録するとともに、この宛先に対応する転送先として広報元であるゲートウェイルータｂのＩＰアドレス（４．４．４．２）を登録する（図２および図３参照）。
【００３６】
このようにして、各ゲートウェイルータに備えられたルーティングテーブルの更新が完了する。
その後に、例えば、図２に示すように、ゲートウェイルータｃに対応するセグメントＣに属するノードＣＮからモバイルノード２１０（図２の符号ＭＮ）を宛先とするパケットが送出されると、このパケットは、以下のようにして、モバイルノード２１０に中継される。
【００３７】
まず、ゲートウェイルータｃに備えられた中継処理部（図示せず）は、図３に示したような情報が格納されたルーティングテーブルに基づいて、このパケットに関するルーティング処理を行う（図２参照）。
このとき、中継処理部は、ロンゲストマッチアルゴリズムに従って宛先のネットワークアドレスを選択することによって、モバイルノード２１０を宛先とするパケットをこのモバイルノード２１０が現在属しているセグメントＢに対応するゲートウェイルータｂに転送することができる（図２参照）。
【００３８】
なぜなら、上述したように、各ゲートウェイルータに備えられたルーティングテーブルにおいては、モバイルノードのＩＰアドレスが３２ビットマスクでネットワークアドレスとして登録されているので、各ゲートウェイルータに備えられた中継処理部は、このネットワークアドレスと宛先のＩＰアドレスを示す全てのビット列とを比較した際に、最も長く一致した旨の比較結果を得るからである。
【００３９】
また、このようにしてモバイルノード２１０宛てのパケットがゲートウェイルータｂに到達したときに、図１に示した中継処理部２２３は、ルーティングテーブル２２４に格納された情報に基づいて、このパケットが自分の配下のセグメントに属するノードに宛てられたものであると判断し、このパケットをＬＡＮ制御部２２２に渡して、セグメントＢにおける転送処理に供する。
【００４０】
このようにして、各ゲートウェイルータに備えられたルーティングテーブルに登録された

モバイルノードについては、ホストルートルーティングによって、転送先を決定することにより、モバイルノードに対応するホームエージェントによって形成されるトンネルルートを経由せずに、発信元のノードＣＮからモバイルノードに至る最短の経路にパケットをルーティングすることができる。

【００４１】

これにより、トンネルルートを経由することによる三角経路の問題を解消し、モバイルノードを宛先とするパケットを最短の経路を介して送信することができるので、モバイルノードがホームネットワークにあるか外部ネットワークにあるかにかかわらず、モバイルノードの利用者に、ＶｏＩＰ技術を利用したアプリケーションやビデオストリームを配信するアプリケーションを適用したサービスを提供することができる。

【００４２】

ところで、発信元のノードＣＮがモバイルノードのホームネットワークに存在している場合には、発信元のノードＣＮは、モバイルノードが自分と同じセグメントに存在することを前提として、ＡＲＰに基づいてＭＡＣアドレスの要求を行い、セグメント内でパケットの転送を実行しようとする。しかしながら、宛先となるモバイルノードが他のセグメントに移動している場合には、当然ながら、ＡＲＰに基づくアドレス要求に対する応答が得られないために、発信元のノードはパケットをモバイルノードに転送することができなくなってしまう。

【００４３】

次に、モバイルノードのホームネットワークに存在する発信元のノードからのパケットをモバイルノードに転送する方法について説明する。

図４に、本発明にかかわるモバイルＩＰネットワークシステムの第２の実施形態を示す。なお、図４に示す構成要素のうち、図１に示した各部と同等のものについては、図１に示した符号を付して示し、その説明を省略する。

【００４４】

図４に示したゲートウェイルータａおよび発信元のノードＣＮは、モバイルノード２１０が本来属しているホームネットワークであるセグメントＡに属している。

図４に示したゲートウェイルータａにおいて、代行処理部２２９は、後述するようにして、モバイルノードに代わって、ＭＡＣアドレス要求に応答し、また、モバイルノード宛てのパケットを受信する機能を備えている。

【００４５】

図５に、モバイルＩＰネットワークシステムの動作を説明する図を示す。

なお、図５において、モバイルノードを符号ＭＮで、ゲートウェイルータａ、ｂ、ｃを符号ＧＷＲａ、ｂ、ｃで、そして、モバイルノードの通信相手のノードを符号ＣＮでそれぞれ示す。

図４に示した代行処理部２２９は、セグメントＡに属する発信元のノードＣＮから発信されたアドレス要求の中から外部ネットワークに移動しているモバイルノードＭＮに対するアドレス要求を検出したときに、このアドレス要求（ＡＲＰ）に対して、自身のＭＡＣアドレスを含む応答（ＰＲＯＸＹ　ＡＲＰ）を要求の発信元のノードＣＮに返す（図５参照）。その後、図４に示した代行処理部２２９は、この発信元のノードＣＮからモバイルノードＭＮ宛てに送出されたパケットをモバイルノードＭＮに代わって受信し（図５参照）、受信したパケットを改めてモバイルノードＭＮを宛先としてＬＡＮ制御部２２２の処理に供する。

【００４６】

この場合に、ＬＡＮ制御部２２２は、モバイルノードＭＮが現在はセグメントＡに存在しないことを認識しているので、代行処理部２２９から受け取ったパケットを中継処理部２２３に渡し、ＷＡＮを介する中継処理に供する。

図５においても示したように、モバイルノードがセグメントＢに移動した段階において、上述したような登録処理が行われており、ルーティングテーブルの更新も完了している。したがって、ゲートウェイルータａに備えられた中継処理部２２３が、ルーティングテー

ブル２２４に格納された情報に基づいてルーティング処理を行うことにより、上述したモバイルノードＭＮ宛てのパケットは、このモバイルノードＭＮが現在登録されているセグメントｂに対応するゲートウェイルータｂに転送され、更に、モバイルノードＭＮに到達する（図５参照）。

【００４７】

このように、本発明にかかわる第２のモバイルＩＰネットワークシステムによれば、モバイルノードのホームネットワークに存在するゲートウェイルータａに、モバイルノードに代わってアドレス要求に応答する機能およびパケットを受信する機能を果たす代行処理部２２９を備えることにより、ホームネットワークに存在する発信元のノードからモバイルノードを宛先としてホームネットワークに送出されるパケットを、外部ネットワークに登録されたモバイルノードに転送することができる。

【００４８】

ところで、モバイルノードが無線通信機能を備えている場合には、通信相手のノードＣＮから例えば音楽ソフトや映像ソフトの配信を受けている最中に、モバイルノードがセグメント間を移動する可能性がある。

次に、無線通信機能を備えたモバイルノードが通信を維持したままセグメント間を移動すること、つまり、ローミングを実現する方法について説明する。

【００４９】

図６に、本発明にかかわる第３のモバイルＩＰネットワークシステムの実施形態を示す。なお、図６に示す構成要素のうち、図１に示した各部と同等のものについては、図１に示した符号を付して示し、その説明を省略する。

図６に示したモバイルノード２１０は、ＬＡＮインタフェース回路２１３に代えて無線ＬＡＮインタフェース回路２３１を備えている。また、図６に示したゲートウェイルータｂもまた、無線ＬＡＮインタフェース２３２を備えている。もちろん、ゲートウェイルータｂは、有線のＬＡＮインタフェース回路（図示せず）を備えていてもよい。

【００５０】

図６に示したモバイルノード２１０の通信制御部２１１は、このモバイルノード２１０が別のノードと通信中に移動し、それまでとは異なるセグメントに進入したときに、通信相手のノードのＩＰアドレスと通信中である旨の情報とを含む登録要求を無線ＬＡＮインタフェース回路２３１を介して送出する。

図６に示したゲートウェイルータｂにおいて、登録処理部２２６は、モバイルノード２１０からの登録要求に通信中である旨の情報が含まれていた場合に、この登録要求に含まれている通信相手のＩＰアドレスとともにモバイルノードのＩＰアドレスを通知処理部２３３に渡し、登録先変更通知の送出を指示する。これに応じて、通知処理部２３３は、登録処理部２２６から渡されたＩＰアドレスを用いて、モバイルノードが登録されているセグメントが変わったことを示す登録先変更通知を作成し、この登録先変更通知を通信相手のノードを宛先とするパケットとしてＬＡＮ制御部２２２に送出する。

【００５１】

一方、図６に示した通信相手のノードＣＮにおいて、サービス処理部２１４は、例えば、映像ソフトの配信サービスに関する処理を行っており、配信対象の映像データを含むパケットを通信制御部２３４を介してネットワークに送出する。また、図６に示した通信制御部２３４は、図１に示した通信制御部２１１と同様の機能に加えて、このノードＣＮと通信中のモバイルノードのローミングに対応するための機能を備えている。

【００５２】

図７に、ローミング処理にかかわる機能の詳細構成を示す。

図７に示した発信元のノードにおいて、通信制御部２３４は、モバイルノードのローミングに対応するために、上述した登録先変更通知を検出する通知検出部２３８と、登録先変更通知にかかわるモバイルノード２１０へのパケットをカプセル化するカプセル化処理部２３９と、モバイルノードへのデータ配信の終了を検出する終了検出部２４０とを備えている。

【００５３】
また、図７に示したゲートウェイルータｂに備えられた中継処理部２２３において、パケット中継制御部２３６は、セグメントＢとＷＡＮとの間におけるカプセル化されていないパケットのやり取りを制御する。一方、図７に示したカプセル解除部２３５は、パケット振分部２３７を介してカプセル化されたパケットを受け取り、カプセル化を解除して得られたパケットをパケット中継制御部２３６を介してセグメントＢに送出する。
【００５４】
以下、図６に示した第３のモバイルＩＰネットワークシステムの動作について説明する。図８に、第３のモバイルＩＰネットワークシステムの動作を説明する図を示す。
なお、図８において、モバイルノードを符号ＭＮで、ゲートウェイルータａ、ｂ、ｃを符号ＧＷＲａ、ｂ、ｃで、そして、モバイルノードの通信相手のノードを符号ＣＮでそれぞれ示す。
【００５５】
例えば、図６に示したモバイルノード２１０がホームネットワークであるセグメントＡに存在しているときは、セグメントＣに属している通信相手のノードＣＮからモバイルノードＭＮ宛てのパケットは、図８に示すように、ＧＷＲｃによってＷＡＮを介してＧＷＲａに渡され、更に、このＧＷＲａを介してモバイルノードＭＮに渡される。この通信相手のノードＣＮとモバイルノードＭＮとの間のコネクションを解放しないままに、モバイルノードＭＮがセグメントＢに移動したときに、図６に示したモバイルノード２１０の通信制御部２１１は、自身のＩＰアドレスに加えて、通信相手のＩＰアドレスと通信中である旨の情報を含んだ登録要求を作成し、無線ＬＡＮインタフェース回路２３１を介してセグメントＢのゲートウェイルータｂにこの登録要求を送出する（図８参照）。
【００５６】
この登録要求に応じて、図６に示したゲートウェイルータｂの登録処理部２２６は、モバイルノード２１０をセグメントＢに登録するための処理を開始するとともに、図６および図７に示した通知処理部２３３に登録先変更通知の送出を指示する。この指示に応じて、通知処理部２３３は、モバイルノード２１０のＩＰアドレスとゲートウェイルータｂのＩＰアドレスとを含む登録先変更通知を作成し、通信相手のノードＣＮを宛先とするパケットとしてＬＡＮ制御部２２２に送出する。
【００５７】
このような登録先変更通知を含んだパケットは、ＬＡＮ制御部２２２から中継処理部２２３に備えられたパケット中継制御部２３６に渡される。このパケット中継制御部２３６は、ルーティングテーブル２２４に格納された経路情報に基づいて、上述した登録先変更通知を含むパケットをＷＡＮインタフェース回路２２５に渡して、ＷＡＮおよびセグメントＣに属するゲートウェイルータｃを介して通信相手のノードＣＮに送出する（図８参照）。
【００５８】
このようにして、登録先変更通知を含むパケットが通信相手のノードＣＮのＬＡＮインタフェース回路２１３に到達したときに、図７に示した通信制御部２３４に備えられた通知検出部２３８は、登録先変更通知から通信相手であるモバイルノード２１０のＩＰアドレスとその登録先において外部エージェント機能を果たすゲートウェイルータｂのＩＰアドレスを抽出し、これらのＩＰアドレスをカプセル化処理部２３９に通知してこのカプセル化処理部２３９を起動する。このカプセル化処理部２３９は、以降に、サービス処理部２１４からモバイルノード２１０を宛先とするパケットを受け取るごとに、このパケットにモバイルノード２１０の新たな登録先であるゲートウェイルータｂのＩＰアドレスを含むヘッダを付加してカプセル化し（図８参照）、このカプセル化されたパケット（以下、カプセル化パケットと称する）をＬＡＮインタフェース回路２１３に渡す。
【００５９】
このカプセル化パケットは、通信相手のノードＣＮのＬＡＮインタフェース回路２１３を介してセグメントＣに送出され、更に、このセグメントＣに属するゲートウェイルータｃ

に渡される（図７、図８参照）。
このカプセル化パケットは、上述したように、ゲートウェイルータｂのＩＰアドレスを含むヘッダを備えている。したがって、ゲートウェイルータｃが、このヘッダに基づいて通常のルーティング処理を行うことにより、このカプセル化パケットは、ＷＡＮを介してモバイルノード２１０の移動先であるゲートウェイルータｂに転送される（図８参照）。、このようなカプセル化パケットがゲートウェイルータｂのＷＡＮインタフェース回路２２５に到達したときに、図７に示した中継処理部２２３に備えられたパケット振分部２３７は、カプセル化パケットをカプセル解除部２３５に渡す。このカプセル解除部２３５は、カプセル化パケットから自身のＩＰアドレスを含むヘッダをはずして、モバイルノード２１０宛てのパケットを分離する。

【００６０】
このようにして分離されたモバイルノード２１０宛てのパケットは、パケット振分部２３７によってカプセル化パケットと分離された通常のパケットとともにパケット中継制御部２３６に渡され、ＬＡＮ制御部２２２および無線ＬＡＮインタフェース回路２３２を介してモバイルノード２１０に渡される（図８参照）。
このようにすれば、各ゲートウェイルータにおけるルーティングテーブルが収束しているか否かにかかわらず、ノードＣＮに備えられたサービス処理部２１４から送出されたパケットを含むカプセル化パケットを、ノードＣＮとゲートウェイルータｂとの間に設定されたトンネルルート（図８において、網掛けを付して示す）を経由してモバイルノード２１０に渡すことができる。

【００６１】
これにより、モバイルノード２１０が通信相手のノードＣＮからの映像データの配信などのサービスを受けながら他のセグメントへ移動する際に、データの配信に必要な通信状態を維持することができる。
上述したトンネルルートを経由したカプセル化パケットの配信は、例えば、配信対象の映像データや音楽データの配信の終了まで同様にして繰り返される。これと並行して、上述した登録要求に応じて、ゲートウェイルータｂがモバイルノード２１０のＩＰアドレスを広報する処理およびこれに応じて各ゲートウェイルータにおいてルーティングテーブルを更新する処理が行われる。

【００６２】
したがって、モバイルノード２１０が登録要求を送出した時点において配信中であったストリームの送信が完了したときには、既に、各ゲートウェイルータに備えられたルーティングテーブルは収束していることが期待できる。
故に、以降に、サービス処理部２１４からモバイルノード２１０宛てに送出されるパケットは、図３に示した場合と同様の手順に従って、収束したルーティングテーブルに基づくルーティング処理によって転送することができる。

【００６３】
ここで、図７に示した終了検出部２４０は、例えば、カプセル化処理部２３９に入力されるストリームデータを監視し、ストリームデータの配信完了を検出したときに、カプセル化処理部２３９にカプセル化処理の停止を指示する機能を備えている。この指示に応じて、カプセル化処理部２３９は、以降は、サービス処理部２１４からのパケットをそのままＬＡＮインタフェース回路２１３に渡す。

【００６４】
このようにすれば、ストリームデータの配信完了に応じて、ノードＣＮとゲートウェイルータｂとの間のトンネルルートを解除し、以降に送信する各パケットをＬＡＮインタフェース回路２１３を介してセグメントＣに送出し、ゲートウェイルータｃによるルーティング処理に任せることができる（図８参照）。
また、例えば、図９に示すような手順を用いれば、ルーティングテーブルの収束完了に応じて、トンネルルートを解除することも可能である。

【００６５】

図９に示すように、モバイルノード２１０の新たな登録先であるゲートウェイルータｂは、自身のルーティングテーブル２２４の更新が完了したときに、発信元としてモバイルノード２１０のＩＰアドレスを示したＰｉｎｇを通信相手のノードＣＮに送信する。
このノードＣＮに対応するゲートウェイルータｃに備えられたルーティングテーブルが収束していれば、ノードＣＮから返されるＰｉｎｇは、ゲートウェイルータｃにより、発信元のモバイルノード２１０が現在属しているセグメントＢに対応するゲートウェイルータｂにルーティングされ、収束していなければ、モバイルノード２１０が前に属していたセグメントに対応するゲートウェイルータにルーティングされる。

【００６６】

したがって、ゲートウェイルータｂは、上述したノードＣＮへのＰｉｎｇに対する応答が返ってくるか否かによって、ノードＣＮに対応するゲートウェイルータｃに備えられたルーティングテーブルが収束しているか否かを判定することができる。
図９に示すように、上述したノードＣＮへのＰｉｎｇに対する応答がゲートウェイルータｃによってゲートウェイルータｂにルーティングされた場合に、ゲートウェイルータｂは、ゲートウェイルータｃに備えられたルーティングテーブルの収束が完了していると判断し、通信相手のノードＣＮにトンネル解除指示を含むパケットを送出する。なお、上述したＰｉｎｇに対する応答の宛先はモバイルノード２１０ではあるが、ゲートウェイルータｂは、この応答をモバイルノード２１０に中継する必要はない。

【００６７】

一方、ゲートウェイルータｂによって送出されたトンネル解除指示は、ゲートウェイルータｃを介してノードＣＮに渡され、これに応じて、ノードＣＮの通信制御部２３４は、サービス処理部２１４からのパケットをカプセル化する処理を停止する。したがって、以降は、配信中のストリームデータを含むパケットは、そのままＬＡＮインタフェース回路２１３を介してセグメントＣに送出され、ゲートウェイルータｃによるルーティング処理に供される。

【００６８】

このような手順を適用してトンネルルートを解除するモバイルＩＰネットワークシステムは、例えば、モバイルノード２１０が登録されるセグメントのゲートウェイルータ（図６ではゲートウェイルータｂ）の中継処理部２２３に、上述した手順を実行してルーティングテーブルの収束完了を判定する収束判定部を備え、また、通信相手のノードの通信制御部２３４に、図７に示した終了検出部２４０に代えて、トンネル解除指示の受付に応じてカプセル化処理の停止を指示する解除指示受付部を備えることによって実現できる。

【００６９】

【発明の効果】

以上に説明したように、本発明にかかわる第１のモバイルＩＰネットワークシステムによれば、ネットワーク中継装置に備えられたルーティングテーブルにモバイルノードのホストアドレスを登録することにより、ホストルートルーティングを利用して、通信相手のノードから送出されたパケットを外部ネットワークに登録されたモバイルノードへ転送することができる。これにより、従来の技術における課題であった三角経路の問題を解消し、モバイルノードが外部ネットワークに登録されている場合においても、通信相手のノードから発信されたパケットを最短の経路を介してモバイルノードに転送することが可能となる。したがって、このような第１のモバイルＩＰネットワークシステムによれば、モバイルノードがホームネットワークにいるか外部ネットワークにいるかにかかわらず、モバイルノードの利用者に、ＶｏＩＰ技術を適用したサービスやビデオストリーム配信サービスなどのような伝送遅延の影響を受けやすいサービスを提供可能となることが期待できる。

【００７０】

特に、本発明にかかわる第２のモバイルＩＰネットワークシステムでは、モバイルノードのホームネットワークに属するノードとの通信の際に、ホームネットワークに属するネットワーク中継装置がモバイルノードに代わって必要な手順を実行することにより、ホームネットワークに属するノードから発信されたパケットも移動先のモバイルノードに確実に

転送することができる。

【００７１】

また、本発明にかかわる第３のモバイルＩＰネットワークシステムによれば、モバイルノードが通信している相手のノードＣＮとモバイルノードの移動先のネットワーク中継装置との間にトンネルルートを設定することにより、モバイルノードの登録先の変更にかかわらず、通信相手のノードＣＮとの間の通信を維持することができる。これにより、例えば、ＶｏＩＰ技術を利用した音声通話などのサービスやビデオストリームの配信サービスなどを受けながら、モバイルノードのユーザがローミングすることも十分に可能となる。

【図面の簡単な説明】

【図１】本発明にかかわる第１のモバイルＩＰネットワークシステムの実施形態を示す図である。

【図２】第１のモバイルＩＰネットワークシステムの動作を説明する図である。

【図３】ルーティングテーブルを更新する動作を説明する図である。

【図４】本発明にかかわる第２のモバイルＩＰネットワークシステムの実施形態を示す図である。

【図５】第２のモバイルＩＰネットワークシステムの動作を説明する図である。

【図６】本発明にかかわる第３のモバイルＩＰネットワークシステムの実施形態を示す図である。

【図７】ローミング処理にかかわる機能の詳細構成を示す図である。

【図８】第３のモバイルＩＰネットワークシステムの動作を説明する図である。

【図９】第３のモバイルＩＰネットワークシステムの別の動作を説明する図である。

【図１０】ＩＰネットワークシステムを説明する図である。

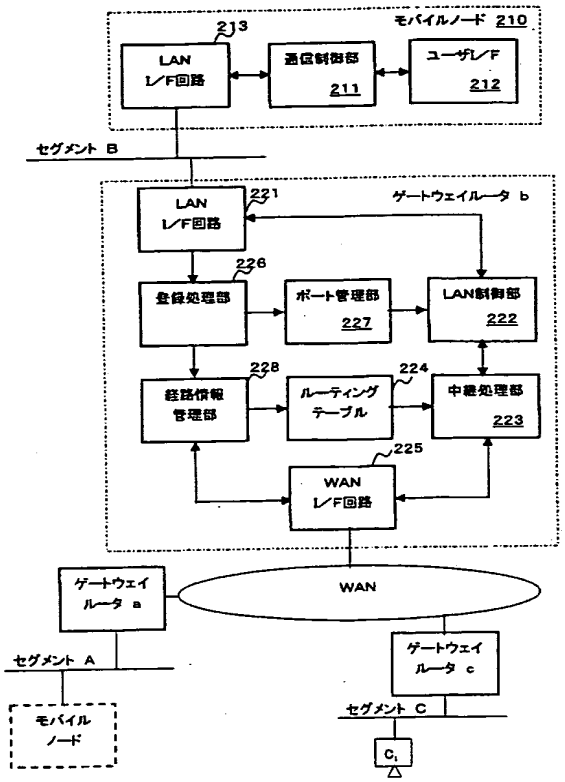
【図１１】モバイルＩＰネットワークシステムを説明する図である。

【符号の説明】

２１０　モバイルノード
２１１、２３４　通信制御部
２１２　ユーザインタフェース（Ｉ／Ｆ）
２１３、２２１　ＬＡＮインタフェース（Ｉ／Ｆ）回路
２２１　ＬＡＮインタフェース回路
２２２　ＬＡＮ制御部
２２３　中継処理部
２２４　ルーティングテーブル
２２５　ＷＡＮインタフェース（Ｉ／Ｆ）回路
２２６　登録処理部
２２７　ポート管理部
２２８　経路情報管理部
２２９　代行処理部
２３１、２３２　無線ＬＡＮインタフェース回路
２３３　通知処理部
２３５　カプセル解除部
２３６　パケット中継制御部
２３７　パケット振分部
２３８　通知検出部
２３９　カプセル化処理部
２４０　終了検出部

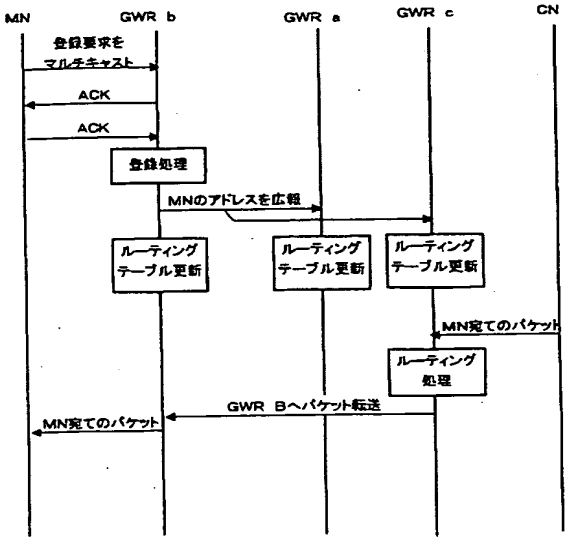
【図１】

本発明にかかわる第1のモバイルIPネットワークシステムの実施形態を示す図



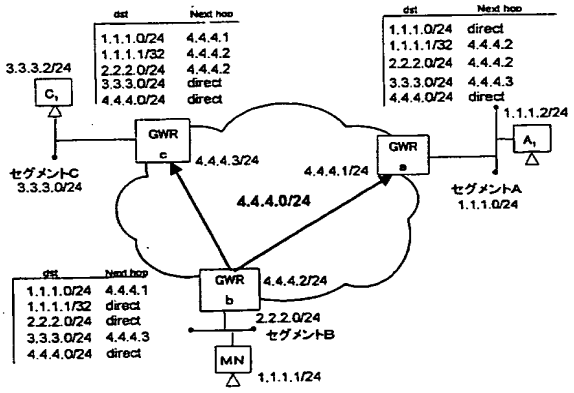
【図２】

第1のモバイルIPネットワークシステムの動作を説明する図



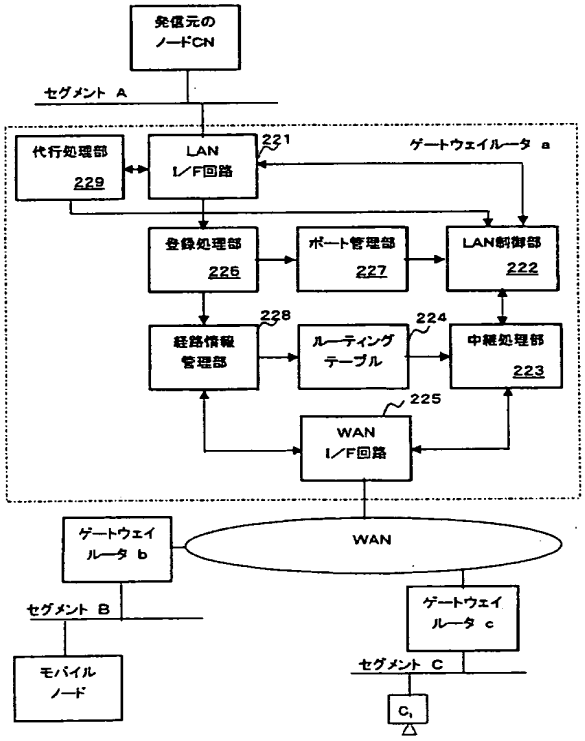
【図３】

ルーティングテーブルを更新する動作を説明する図



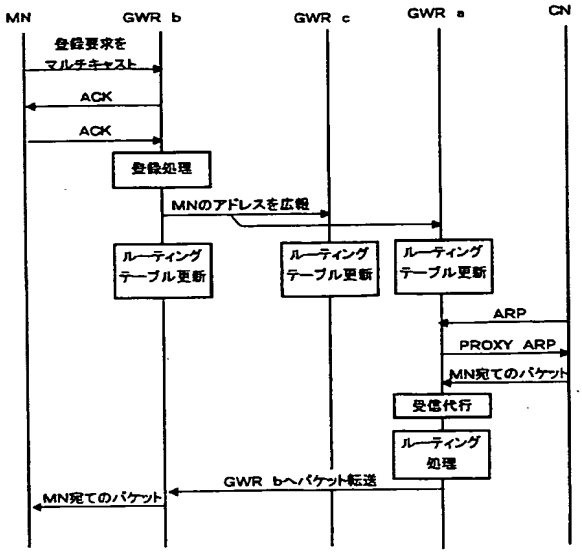
【図４】

本発明にかかわる第2のモバイルIPネットワークシステムの実施形態を示す図



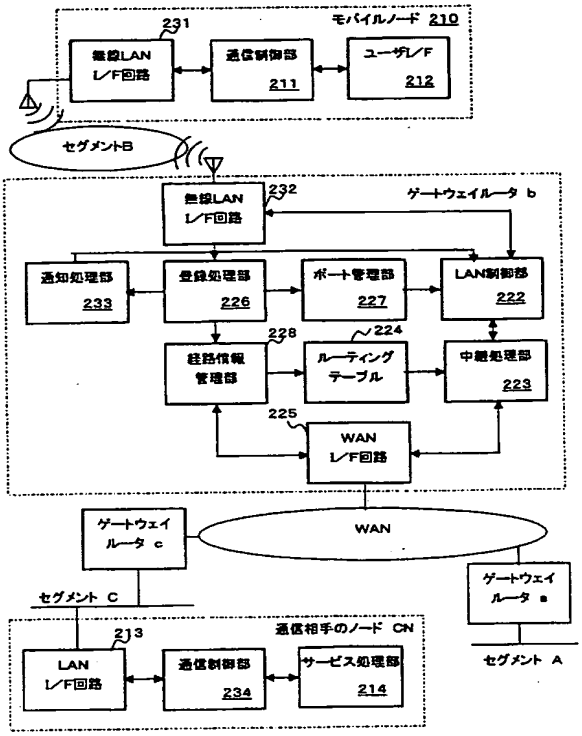
【図５】

第2のモバイルIPネットワークシステムの動作を説明する図



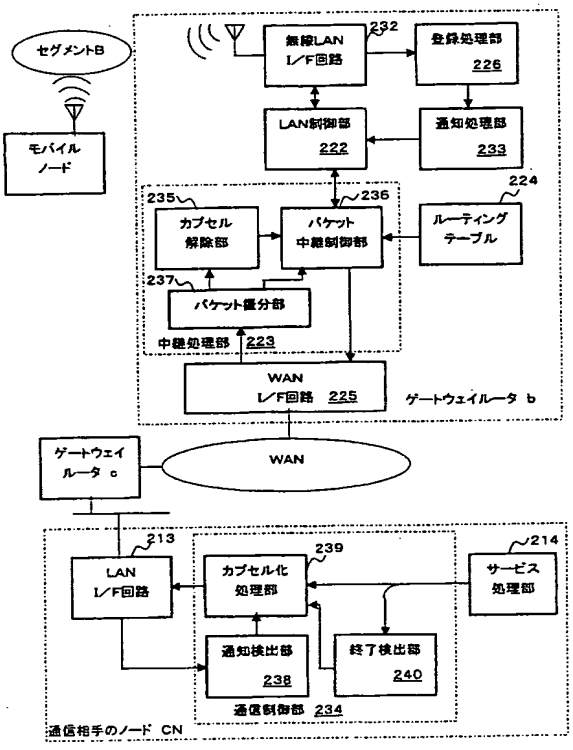
【図６】

本発明にかかわる第3のモバイルIPネットワークシステムの実施形態を示す図



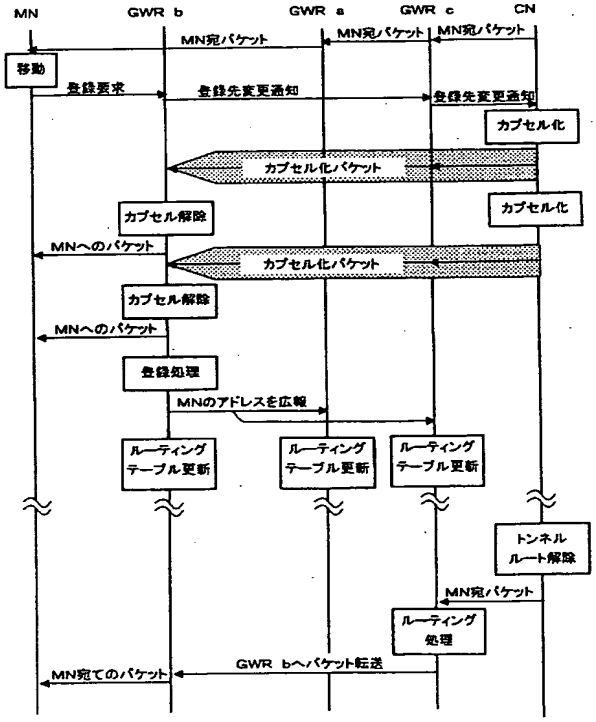
【図７】

ローミング処理にかかわる機能の詳細構成を示す図



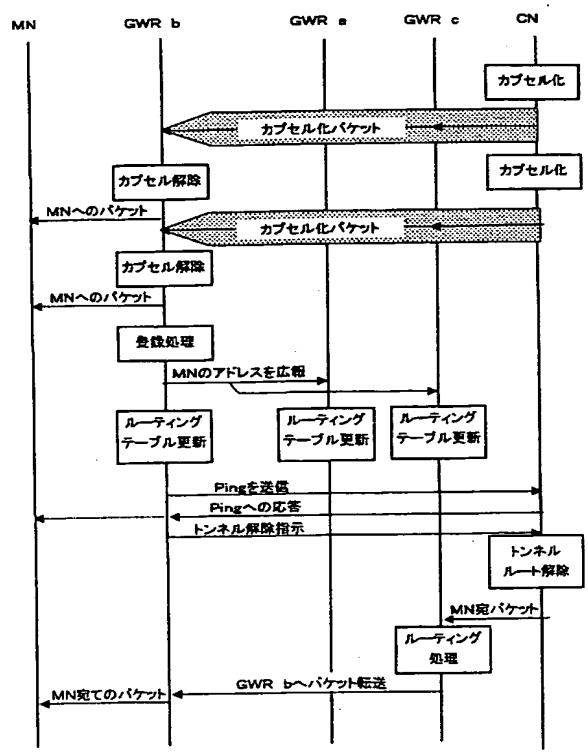
【図８】

第3のモバイルIPネットワークシステムの動作を説明する図



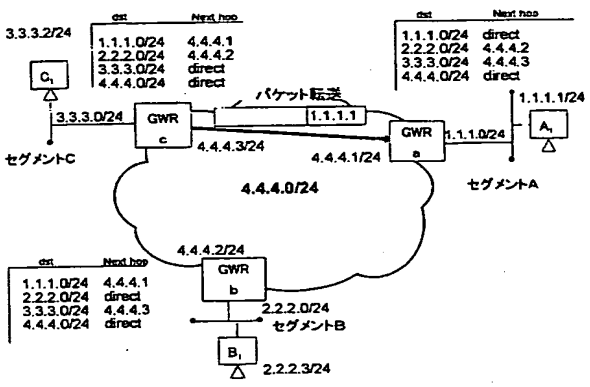
【図９】

第3のモバイルIPネットワークシステムの別の動作を説明する図



【図１０】

IPネットワークシステムを説明する図



【図１１】

モバイルIPネットワークシステムを説明する図